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## Comparison of postpartum depression at six weeks among caesarean and vaginally delivered women in Pune District, India

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**Comparison of postpartum depression at six weeks among caesarean and vaginally delivered women in Pune District, India**

Dr. Prakash Prabhakar Rao Doke,<sup>1</sup>

Dr. Varsha Mahesh Vaidya,<sup>1</sup>

Dr. Arvinder Pal Singh Narula,<sup>1\*</sup>

Dr. Manjiri Chaitanya Datar,

Dr. Archana Vasantro Patil,<sup>2</sup>

Dr. Tushar Madhav Panchanadikar,<sup>1</sup>

Dr. Girija Narendra Wagh,<sup>1</sup>

<sup>1</sup>Bharati Vidyapeeth Deemed University Medical College, Pune, India

<sup>2</sup> Directorate of Health Services, Government of Maharashtra, Pune, India

\* Corresponding author

Dr. Arvinder Pal Singh, Narula

Address: Department of Community Medicine, Bharati Vidyapeeth Deemed University Medical College, Satara Road, Dhanakawadi, Pune, India, 411043

Email: arvindernarula@rediffmail.com

Telephone: +9108805984393

Fax: +9102024372175

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**Comparison of postpartum depression at six weeks among caesarean and vaginally delivered women in Pune District, India**

**ABSTRACT**

**Objectives** To compare the proportion of postpartum depression at six weeks among caesarean delivered and vaginally delivered women and to assess its association with some socio-demographic factors.

**Design** It was a descriptive comparative study with prospective enrolment. We followed the enrolled women and assessed them for postpartum depression six weeks after delivery.

**Setting** We conducted the study in Pune district, India from July 2017 to December 2018. The study sites were all non-teaching government hospitals performing five or more caesarean section deliveries per month and two teaching hospitals one government and one private

**Participants** Women undergone caesarean section in participating hospitals and residents of Pune district were included in the study group. The women delivered vaginally and matching in age and parity were included in the comparison group. We followed 1,556 women in each group.

**Main outcome measures** Edinburgh Postnatal Depression Scale (EPDS) score for each woman was the major outcome. Chi-square test and adjusted odds ratio using multivariate analysis was calculated.

**Results** The proportion of postpartum depression was 3.79% among caesarean delivered women and 2.35% among vaginally delivered women at six weeks (Chi square=4.50; p=0.03). The adjusted odds ratio was 1.86 (95% CI=1.104 to 3.03; p=0.02). Age 25 years and more confers some protection (adjusted odds= 0.48; 95% CI =0.27 to 0.83; p=0.01). Even the proportion of women scoring six to nine was significantly higher among caesarean delivered women than

vaginally delivered (Chi square=8.22; p=0.04). The study did not observe any association between postpartum depression and income, education, occupation or sex of the new-born child.

**Conclusions** We conclude that young women particularly caesarean delivered should be screened six weeks after delivery. A cut off point of six can be considered for screening women after delivery.

**Keywords:** Postpartum Depression; Prevalence; Caesarean delivery; Socio-demographic characteristics; Gender

### **Strengths and limitations of this study**

- ▶ The present study is a large multi-site study representing about 10 million population.
- ▶ Trained health care workers assessed the women six weeks postpartum.
- ▶ The study asserted that young and caesarean delivered women are having higher risk
- ▶ Authors didn't assess or ask history of postpartum depression during pregnancy or immediately after delivery.
- ▶ We did not include private hospitals.

**Comparison of postpartum depression at six weeks among caesarean and vaginally delivered women in Pune District, India**

**INTRODUCTION**

**Background**

Women face major depression 1.6 to 2.6 times more than men<sup>1</sup>. This difference is most apparent in the postpartum period. Studies identifying its risk factors are fewer than studies estimating incidence/prevalence.<sup>2-5</sup> The risk factors are classified as socio-economical and biological. The risk factors may be present during pregnancy or appear after childbirth.<sup>1,6</sup> The socio-economic factors and disparity in the assessment (including time of assessment after birth and the tool used) is also major determinants. The American Psychiatric Association’s Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5), rather than defining postpartum depression, specifies it as; ‘most recent episode of major depression if onset of mood symptoms occurs during pregnancy or in the four weeks following delivery’.<sup>7</sup> Most psychiatrists and obstetricians consider the period up to one year.<sup>2,4,8-13</sup> But the symptoms can persist for more than a year.<sup>6</sup> There is universal agreement that postpartum depression is a disabling but treatable mental disorder which is one of the common complications of childbearing. Edinburgh Postnatal Depression Scale (EPDS) is the most commonly used tool for assessment. The consequences of PPD are of the three types; (1) related to mother, (2) related to the child, and (3) mother-child interactions. The first category includes a woman’s social relationship including with her husband. Severe malnutrition, health problems like diarrhea, language and cognitive development among the children, represent the second category. Mother to child bonding, breastfeeding problems represent the third category.<sup>1,14,15</sup>

The psychiatric risk factors receive more attention than the obstetric factors. Mode of delivery is one of the recognized risk factors. Some studies have shown a higher risk of occurrence of postpartum depression after cesarean section,<sup>16,17</sup> but some studies did not.<sup>18,19</sup> Most of these studies are small and from a single institution. On the other hand, some large studies did not include the mode of delivery as a risk factor.<sup>3,20</sup> The woman undergoing cesarean section has mental stress due to exposure to operation and expenditure incurred. Additionally, the feeling of guilt exists, as the cesarean mode of delivery is taken as a failure on the part of the mother to endure pain contributes. Hence postpartum depression is more likely to occur among cesarean delivered women than vaginally delivered. We perceived the need for a comparative study because globally the proportion of cesarean is increasing. Over and above, authors considered sex of the new-born, as some Indian studies have observed that the birth of a girl child is also a risk for PPD.<sup>17,21,22</sup> In India, despite the launch of the National Mental Health Programme in 1982, maternal mental is not given due attention.

## Objectives

1. To compare the proportion of PPD at six weeks between cesarean delivered and vaginally delivered women, in Pune District
2. To assess its association with socio-economic factors including the sex of the new-born.

## MATERIAL AND METHODS

### Study Design

It was an observational and descriptive study comparing PPD six weeks after delivery among women who have undergone caesarean and vaginal delivery.

### Settings



Pune District is the second populous district in Maharashtra State, and fourth in India, having a population of 9,429,408, as per the last census 2011. Pune Municipal Corporation together with Pimpri Chinchwad Municipal Corporation constitutes 51.46% of the district population. The female to male (per 1,000) ratio is 915 and the female literacy rate is 81.05%. We included all non-teaching government hospitals (conducting at least five cesareans per month), one government teaching hospital, and one private teaching hospital (the nodal site). This study was conducted in collaboration with the Directorate of Health Services Government of Maharashtra. The selected hospitals included, five tertiary care hospitals (two medical college hospitals, one district hospital, two municipal corporation hospitals), six sub-district hospitals (includes one women’s hospital), and two community health centers from different places. The details are depicted in figure 1.

**Period**

The study duration was from 1<sup>st</sup> July 2017 to 31<sup>st</sup> December 2018 including the enrolment period from 1<sup>st</sup> September 2017 to 31<sup>st</sup> March 2018.

**Follow-up**

All women were requested to come for follow-up at six weeks (coterminous with the initiation of immunization to their child) at the hospitals. Women were frequently reminded on phone about their due visit. Women not attending the hospital were invited for specially organized follow-up camps. Health care workers visited the houses of the women who did not attend the institution or camp and requested them to come for follow-up. A social worker conducted telephonic interview of the women who neither visited institution nor follow-up camp. The follow-up was started on 16<sup>th</sup> October 2017 and stopped on 30<sup>th</sup> June 2018. All women suspected of having postpartum depression were advised to consult a psychiatrist.

## Data collection

A pair consisting an obstetrician and the in-charge nurse was identified as ‘coordinator team’ from each participant hospital and in the medical college hospitals, unit-wise teams were formed. The Department of Community Medicine and Psychiatry trained them along with the research team (one coordinator who was a public health specialist and two medico-social workers). It was one-day training including an introduction to the study, collection of initial information, follow-up and monitoring, and filling the EPDS format. Trainees practiced filling of EPDS format interviewing colleague as a delivered woman. Women were enrolled before discharge (48 hours to seven days after delivery). The initial part of the format was filled by collecting information from records as well as through face-to-face interviews, by a member of the coordinator team. They were again interviewed during follow-up visits and responses were recorded on the printed EPDS format by the coordinator team. Women visiting the nodal site (delivered in that institution and some women from nearby areas) were assessed by a psychiatrist. The research coordinator and the two medico-social workers supervised and coordinated follow-up and data collection. Authors along with the research coordinator regularly visited all the sites. From the rural areas the filled-up forms were collected monthly or during visits and from corporation areas forms were weekly collected. They were scrutinized and women were contacted on the phone if needed.

## Participants

A woman who was a resident of the Pune district and ready to come for follow-up was eligible for inclusion. A woman not knowing even one language out of English, Marathi, or Hindi; having critical illness needing immediate transfer to a higher institution (non-study site), and or with serious psychiatric illness (unable to understand and respond) at the time of enrolment

interview was excluded. All women who had undergone caesarean section during the enrolment period were included as ‘study participants’ till the desired sample size was achieved. After enrolment of a woman in the study group, the subsequent first vaginally delivered woman matching in age ( $\pm 2.5$  years) and parity was included in the comparison group.

**Variables**

Information about the mode of delivery, age, parity, education, family income, and occupation, based on Kuppuswamy’s classification was collected.<sup>23</sup> Income was based on the colour of the ration card. The government has provided yellow, orange, and white colour ration cards to families having annual income less than Rs.15,000, Rs.15,000 to Rs.99,999, and Rs.100,000 or above respectively. Yellow ration card holders are considered as Below Poverty Line (BPL) and are eligible for benefits under some schemes. For each woman, depression score was calculated by using EPDS that was developed by Cox JL in 1987.<sup>24</sup> It is a ‘10 item’ scale assessing various aspects of depression on a week recall of mood and feelings. Each item is scored on a severity scale ranging from 0 to 3, thus the possible highest total score is 30.

**Data sources/measurement**

The source of data was the case report form. The interview schedule comprised of information about the socio-economic characteristics of the participants, detailed obstetric history. During the follow-up visit at six weeks, the woman was assessed for PPD by using EPDS which was validated and translated into Marathi (local language). The data was entered on the Excel Sheet. Then the total score of each woman was calculated. The woman with a cut-off score  $\geq 10$  was considered as having postpartum depression.

**Bias**

The translated EPDS format was not having any identification marker about the mode of delivery and thus the assessors were blinded to the mode of delivery.

### **Study Size**

To capture a PPD difference of 7.6% between caesarean section and vaginal delivery,<sup>13</sup> with a 95% confidence and 80% power, the sample size required was 228 in each group. However, this study was a part of a larger study in which a comparison of puerperal infection was studied. Based on available rates of puerperal infection, 1,556 participants in each group were enrolled and followed.

### **Statistical methods**

Descriptive statistics as percentages for the categorical variables were tabulated for selected predictors. The data analysis was done using, 'Statistical Package for the Social Science' (SPSS) Version 25.0. Chi-square test with Yates's correction was applied to assess the association between PPD and socio-demographic and obstetric parameters of the participants. The adjusted odds ratio was calculated. P-value <0.05 was considered to be statistically significant.

### **Patient and Public Involvement**

Participant women were not involved in study design but they were given all information about the study and referred whenever necessary. Officers from the health department were involved in the study design.

## **RESULTS**

During the enrolment period in the selected 13 hospitals, 6,567 cesareans and 14,049 vaginal deliveries were conducted. About 40% of cesarean delivered women were not eligible due to residence outside Pune District and 40% were unwilling to come for follow-up. Around 15%

were excluded due to the language barrier and about 5% were critically ill or having a psychiatric problem.

The number of mothers contacted directly during a hospital visit, through camps and phone calls was roughly 50%, 30%, and 20% respectively.

We followed 2,831 women (90.97%) at six weeks. The details about delivered, enrolled, and followed women are given in figure 2. Illegible handwriting plus the inability to confirm the contents on the phone and unfilled sections were the common reasons for incomplete data. Some women were not available on the phone and some migrated to other districts.

**Socio-demographic characteristics**

Out of 3,112 participants, the data from the varied number of women could not be obtained for certain variables. About 68% of participants were from urban areas. Table 1 gives only socio-demographic characteristics of the participants.

The mean age of participants was 23.96 ( $\pm 3.72$ ) years. The younger age group up to 25 years was the dividing line. The proportions of women in younger age groups were lesser among caesarean delivered than vaginally delivered. The overall proportion of the first para plus 2<sup>nd</sup> para was 85.57% and there was no difference between the two groups. The proportion of post-secondary school certificate qualifications among caesarean was 43.22% while it was 34.07% among vaginally delivered.

**Postpartum Depression at six weeks**

We could not interview 8.48% and 9.58% of participants from the caesarean and comparison group respectively. The proportion of postpartum depression having EPDS score of 10 or more was 3.79% among caesarean and 2.35% among vaginally delivered women (Chi-square=4.96;

p=0.03). The details about the mode of delivery and EPDS score group are given in table 2 which reveals that a score of six and above was higher among the caesarean delivered women. The distribution of EPDS scores by types of LSCS is given in table 3. Among emergency caesarean delivered women scores were higher in all groups (excepting 1 to 5 group). The adjusted odds ratios for various factors are given in table 4. The study did not find any association between PPD and multiple births.

## Discussion

The present multisite study involving a large number of participants is the second largest one among all the referred studies from the last two decades.<sup>25</sup> For better supervision and thereby assurance of quality, we limited the number of participating hospitals by applying the selection criterion. We did the homework of calculating adjusted relative risk due to caesarean deliveries. But authors were bound to ignore it. Because neither the assessment was done during pregnancy nor immediately after delivery. The history was also not asked. But we assume whatever a small proportion of women have such a history, the proportion is ought to be similar in both the groups. However, realizing the limitations, we calculated the odds ratio for various factors. The results were almost similar to the relative risk. Although the American Psychiatric Association included symptoms occurring within four weeks of delivery under postpartum depression, the study considered the conventional obstetric postpartum period of six weeks. In India, post-natal visits are less frequent than ante-natal visits. During post-natal visit assessment for PPD is not carried out. Women due to socio-cultural traditions usually do not move out of the home for about six weeks. The women visit the institutions for the initiation of vaccination to their children and hence the number of lost follow-up was less than 10%. Although our study was confined mostly to the government hospitals, any private hospital providing immunization

services can start assessing the women. The present study used the EPDS tool to assess PPD and the cut-off point was considered as 10 and above. Many studies considered a higher score of 12 or 13 as cut-off point.<sup>5,9,30,31,10,11,17,22,26–29</sup> But several studies have considered a cut-off of 10 points like the present study.<sup>2,4,13,14,32–35</sup> In some studies, a cut-off of nine score was considered for assessment of depression.<sup>6,36</sup> In a large study conducted in China, even a score of seven was considered to describe mild depression.<sup>37</sup> EPDS is not a diagnostic tool but it is a screening tool. It is logical to consider a cut-off point of six, for mild depression and the women can undergo clinical review. A score of 6 and above by EPDS had already been used and had 100% sensitivity and is quoted in a document by WHO.<sup>6</sup> It may have low specificity. But screening tests are meant to capture maximum suspected patients for further evaluation.

The range of PPD observed in India varies from 7.5 to 31.4%.<sup>2,4,28,33,38–41,13,14,16,18,19,21,22,27</sup> A meta-analysis of Indian studies observed a range of 3 to 47%; concluded that the average proportion of PPD was 19%.<sup>41</sup> The meta-analysis as well as the references quoted in the present study pointed out the higher prevalence in South India. In the same meta-analysis, an upward trend was mentioned; but the authors did not observe any trend in the occurrence of PPD while analysing the referred studies in this article. This can be due to two reasons; firstly, we have referred to fewer articles and secondly, they are relatively recent. The meta-analysis also observed that the prevalence was higher in urban areas than rural areas and a higher proportion was reported from studies in hospital settings than in community settings.<sup>41</sup> Our estimated prevalence of PPD is on the lower side. It is documented that economic and health indicators affect the PPD.<sup>42</sup> Pune District is having better health and economic indicators.<sup>43</sup> The assessors were not psychiatrists or psychologists, some responses were through phone calls. But

both these practices are documented. The findings have to be viewed in the context that the present study is the largest in India covering both the urban and the rural areas.

The range of proportion of PPD reported during the last two decades in various countries was from 5.3% in Turkey to 42.6% in California, USA.<sup>10,13,17,19,25,29,30,32,44</sup> WHO had quoted studies wherein the PPD ranged from 10% in Uganda to 40% in Pakistan.<sup>1</sup> In another report reviewing maternal mental health specifically in low and middle-income countries, the prevalence ranged from 10.7% in Nigeria to 50% in Guyana.<sup>6</sup> In a global review, minimum PPD (4%) from Japan and high PPD (63.9%) in America were noted.<sup>45</sup> A review from Asian countries pointed out that Malaysia had the lowest PPD (3.5%) and Pakistan had the highest (63.3%).<sup>46</sup> The lower prevalence in our study is not an outlier. Even this low prevalence amounts to about 50,000 cases in the state. If PPD is untreated, the new-born and the whole family may face some consequences.

Apart from socio-cultural and biological factors, the tool of assessment is also an important determinant. The most used tool is EPDS which is in vogue since the 1980s.<sup>45</sup> There ought to be inconsistency when different tools are used. It is also determined by the accepted cut-off point. EPDS cut-off points from 7 to 13 have been used by various investigators. One report had quoted studies demonstrating the effects of the assessment system, changing cut-off points, and time of assessment.<sup>6</sup> The time of assessment is an important factor. The studies have been conducted as early as within three days<sup>39</sup> to one year.<sup>9,11,14,32</sup> An inexperienced person may classify maternal blues as PPD which has a similar presentation and appears within few days of delivery. It is observed that the prevalence of PPD decreases with time.<sup>30</sup> The meta-analysis study in India observed that pooled prevalence of 22% got reduced to 19% after deducting studies assessing PPD within two weeks.<sup>41</sup>



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The association of PPD with age is inconsistent; some did not show any association PPD,<sup>4,5,13,36</sup> but some did.<sup>2,40</sup> Few studies have reported that increasing age heightens the chances of getting PPD particularly after 30 years.<sup>9,22,27</sup> The pooled prevalence of PPD was estimated as 20% and 21% when studies with mean maternal age of  $\leq 25$  years and  $> 25$  years but the difference was not significant.<sup>41</sup> But chances are very high among women less than 20 years.<sup>40</sup> The present study confirms that age above 25 years confers protection as the adjusted odds ratio is 0.49. The higher risk is bi-polar; young<sup>40</sup> and middle-aged are at high risk.<sup>9,22,27</sup> This can be a reflection of better psycho-social adjustment within the family by 25 years of age. The present study did not find any association between income and PPD. The risk may be inversely proportional to income,<sup>47</sup> but may not be a uniform finding.<sup>5</sup> The present study did not observe any association with employment. Some studies observed association,<sup>14,27</sup> and one didn't.<sup>4</sup> In Indian society, if the woman is having one or more girls; the birth of a male child is preferred. The woman is blamed or made to feel guilty for giving birth to a female child. Many studies reported a higher prevalence of PPD after the birth of a female child.<sup>17,22,37</sup> Like the present study, few studies did not observe such association.<sup>11,30</sup> The problem is state or district-specific. Additionally, in the last two decades, extensive efforts have been taken by the government and non-governmental agencies to create awareness about gender bias.

Even WHO did not include the mode of delivery in the risk factor list.<sup>6</sup> Some studies including a review study did not consider the effect of the mode of delivery.<sup>3,35</sup> With the increasing number of caesarean sections, ascertaining its effect on PPD is necessary. It is mentioned that caesarean delivery is associated with a higher risk for PPD.<sup>1</sup> But there is no concordance between the results of various studies. Some studies did not show an association between the mode of delivery and PPD.<sup>18,19,27-29,44</sup> In some studies, an association was observed

but not significant or disappeared after adjusting for confounders.<sup>5,8,17,25,37,48</sup> One reason for the non-significant difference is the inadequacy of sample size. Many studies showed a significantly higher increased risk due to caesarean section.<sup>31–33</sup> All four comparative studies involving 50 to 100 participants in each group observed a higher risk of PPD among caesarean delivered women.<sup>16,33,34,39</sup> Two meta-analyses clearly showed increased risk due to caesarean section.<sup>49,50</sup> Only two studies reported a higher risk with vaginal delivery.<sup>8,13</sup> PPD is related to the pain that a woman undergoes during and after episiotomy, repair of tear or forceps application, etc.<sup>44</sup> The higher risk of PPD due to caesarean section can be consequent to postpartum complications which include infection, haemorrhage, intra-operative complications and result in blood transfusion, longer hospital stay, and higher expenditure.<sup>51,52</sup> Secondly, women undergoing non-vaginal delivery can have more probability of self-reported symptoms.

The comparison between elective and emergency caesarean is full of variations. There was no difference between an emergency and elective caesarean section<sup>5</sup>. Some studies reported higher risk with elective cesareans,<sup>17,31</sup> while one study reported opposite findings.<sup>50</sup> A higher risk of PPD after an emergency caesarean section is a reflection of acute stress reactions.<sup>1</sup> The present study did not find any consistent difference.

We did not include private hospitals, the time of onset of the symptoms. The assessment was done only at six weeks. A psychiatrist did not assess all the women. Complete blinding was not possible as many interviewers knew the women. Some interviews were telephonic. The authors did not separately analyse data by mode of collection or person collecting. The overall prevalence may not apply to the general population because the proportion of caesarean is less than 50%.

## Conclusions

The study confirmed younger age and caesarean are risk factors. In all hospitals at six weeks postpartum, universal assessment of delivered women, particularly young and caesarean delivered, through nurses or medico-social workers by using EPDS score should be initiated. The sensitivity and specificity studies using six or more EPDS score need consideration.

**Contributors** PPD was involved in planning, data analysis and writing manuscript. VMV and APSN were involved in planning and supervision. MCD was involved in training and assessment. AVP was involved in monitoring follow up. TMP was involved in supervision, monitoring and collection of data. GNW was involved in supervision and collection of data. All the authors contributed to writing manuscript and approved the manuscript.

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**Competing interests** All authors declare that competing interests are nil.

**Patient and public involvement** Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

**Consent for participation and publication** The authors obtained consent for participation and publication from all the participants.

**Ethics approval** The study was approved by the Institutional Ethics Committee (DCGI Regd. No. ECR/313/Inst/MH/2013/RR-16) vide letter number IEC/2017/34 Date: 31Aug 2017.

**Data sharing statement** All the data will be shared on reasonable request to corresponding author.

**REFERENCES**

1. WHO and UNFPA. *Mental Health Aspects of Women's Reproductive Health.*; 2009.
2. Agarwala A, Arathi Rao P, Narayanan P. Prevalence and predictors of postpartum depression among mothers in the rural areas of Udupi Taluk, Karnataka, India: A cross-sectional study. *Clin Epidemiol Glob Heal.* 2019;7(3):342-345.  
doi:10.1016/j.cegh.2018.08.009
3. Beck CT. Predictors of Postpartum Depression. *Nurs Res.* 2001;50(5):275-285.  
doi:10.1089/jwh.2014.4824
4. Gaikwad S, Mundada V, Dhande V, Doibale M. Assessment of postnatal depression and some associated risk factors among mothers attending the immunisation outpatient department in a tertiary health care centre : a cross sectional study. *Int J Community Med Public Heal.* 2019;6(10):4412-4416.
5. Goker A, Yanikkerem E, Demet MM, Dikayak S, Yildirim Y, Koyuncu FM. Postpartum Depression: Is Mode of Delivery a Risk Factor? *ISRN Obstet Gynecol.* 2012;2012:1-6.  
doi:10.5402/2012/616759
6. WHO and UNFPA. *Maternal Mental Health and Child Health and Development in Low and Middle Income Countries.*; 2008. Accessed June 23, 2020.  
[https://www.who.int/mental\\_health/prevention/suicide/mmh\\_jan08\\_meeting\\_report.pdf?ua=1](https://www.who.int/mental_health/prevention/suicide/mmh_jan08_meeting_report.pdf?ua=1)
7. American Psychiatric Association. *Diagnostic and Statistical Manual Fo Mental Disorder DSM-5.* Fifth. American Psychiatric Publishing; 2013.
8. Chaaya M, Campbell OMR, El Kak F, Shaar D, Harb H, Kaddour A. Postpartum depression: Prevalence and determinants in Lebanon. *Arch Womens Ment Health.* 2002;5(2):65-72. doi:10.1007/s00737-002-0140-8

9. Inandi T, Elci OC, Ozturk A, Egri M, Polat A, Sahin TK. Risk factors for depression in postnatal first year, in eastern Turkey. *Int J Epidemiol.* 2002;31(6):1201-1207. doi:10.1093/ije/31.6.1201

10. Kaya L, Cigdem Z. The relationship between mode of delivery and postpartum derpression. *J Heal Educ Promot.* 2019;8(5):1-6. doi:10.4103/jehp.jehp

11. Lagerberg D, Magnusson M. Infant gender and postpartum sadness in the light of region of birth and some other factors: A contribution to the knowlegeof postpartum depression. *Arch Womens Ment Health.* 2012;15(2):121-130. doi:10.1007/s00737-012-0265-3

12. Regmi S, Sligl W, Carter D, Grut W, Seear M. A controlled study of postpartum depression among Nepalese women: Validation of the Edinburgh Postpartum Depression Scale in Kathmandu. *Trop Med Int Heal.* 2002;7(4):378-382. doi:10.1046/j.1365-3156.2002.00866.x

13. Shriraam V, Shah PB, Anitha RM, BWC S. A community-based study of postpartum depression in rural South India. *Indian J Soc Psychiatry.* 2019;35:64-68. doi:10.4103/ijsp.ijsp\_13\_18

14. Amipara T, Baria H, Nayak S. A study on postpartum depression and its association with infant feeding practices and infant nutritional status among mothers attending the anganwadi centers of Valsad district, Gujarat, India. *Indian J Community Med.* 2020;45(3):299. doi:10.4103/ijcm.IJCM\_171\_19

15. Slomian J, Honvo G, Emonts P, Reginster JY, Bruyère O. Consequences of maternal postpartum depression: A systematic review of maternal and infant outcomes. *Women's Heal.* 2019;15. doi:10.1177/1745506519844044

16. Dinesh P, Raghavan S. A comparative study of prevalence of postnatal depression among

- subjects with normal and cesarean deliveries. *IAIM*. 2018;5(2):6-11.
17. Johnstone SJ, Boyce PM, Hickey AR, Morris-Yates AD, Harris MG. Obstetric risk factors for postnatal depression in urban and rural community samples. *Aust N Z J Psychiatry*. 2001;35(1):69-74. doi:10.1046/j.1440-1614.2001.00862.x
18. Patel V, Rodrigues M, Nandita DeSouza M. Gender, Poverty, and Postnatal Depression: A Study of Mothers in Goa, India. *Am J Psychiatry*. 2002;159:1.
19. Sheela CN, Venkatesh S. Screening for Postnatal Depression in a Tertiary Care Hospital. *J Obstet Gynecol India*. 2016;66(1):72-76. doi:10.1007/s13224-015-0766-x
20. Faisal-Cury A, Menezes PR. Type of delivery is not associated with maternal depression. *Arch Womens Ment Health*. 2019;22(5):631-635. doi:10.1007/s00737-018-0923-1
21. Jain A, Tyagi P, Kaur P, Puliyel J, Sreenivas V. Association of birth of girls with postnatal depression and exclusive breastfeeding: An observational study. *BMJ Open*. 2014;4(6). doi:10.1136/bmjopen-2013-003545
22. Modi VP, Parikh MN, Kartik VS. A Study on Prevalence of Postpartum Depression with Risk Factors. *Ann Indian Psychiatry*. 2018;2(June):27-32. doi:10.4103/aip.aip
23. Wani R. Socioeconomic status scales-modified Kuppaswamy and Udai Pareekh's scale updated for 2019. *J Fam Med Prim Care*. 2019;8(6):1846. doi:10.4103/jfmpe.jfmpe\_288\_19
24. Cox JL, Holden JM, Sagovsky R. Detection of Postnatal Depression: Development of the 10-item Edinburgh Postnatal Depression scale. *Br J Psychiatry*. 1987;150(JUNE):782-786. doi:10.1192/bjp.150.6.782
25. Eckerdal P, Georgakis MK, Kollia N, Wikström A-K, Högberg U, Skalkidou A. Delineating the association between mode of delivery and postpartum depression

symptoms: a longitudinal study. *Acta Obstet Gynecol Scand.* 2018;97(3):301-311.  
doi:10.1111/aogs.13275

26. Gierszewska M, Kaźmierczak M, Araszkiewicz A, Gebuza G, Mieczkowska E, Gierszewska M. Psychosocial determinants of postpartum depression. *Med Biol Sci.* 2014;28(3):25-33. doi:10.12775/mbs.2014.022

27. Saldanha D, Rathi N, Bal H, Chaudhari B. Incidence and evaluation of factors contributing towards postpartum depression. *Med Jpurnal Dr DY Patil Univ.* 2014;7(1102):309-316. doi:10.4103/0975-2870.128972

28. Shivalli S, Gururaj N. Postnatal depression among rural women in south India: Do socio-demographic, obstetric and pregnancy outcome have a role to play? *PLoS One.* 2015;10(4). doi:10.1371/journal.pone.0122079

29. Sword W, Kurtz Landy C, Thabane L, et al. Is mode of delivery associated with postpartum depression at 6 weeks: A prospective cohort study. *BJOG An Int J Obstet Gynaecol.* 2011;118(8):966-977. doi:10.1111/j.1471-0528.2011.02950.x

30. Sylvén SM, Papadopoulos FC, Mpazakidis V, Ekselius L, Sundström-Poromaa I, Skalkidou A. Newborn gender as a predictor of postpartum mood disturbances in a sample of Swedish women. *Arch Womens Ment Health.* 2011;14(3):195-201. doi:10.1007/s00737-011-0211-9

31. Xie RH, Lei J, Wang S, Xie H, Walker M, Wen SW. Cesarean section and postpartum depression in a cohort of chinese women with a high cesarean delivery rate. *J Women's Heal.* 2011;20(12):1881-1886. doi:10.1089/jwh.2011.2842

32. Kim Y, Dee V. Sociodemographic and Obstetric Factors Related to Symptoms of Postpartum Depression in Hispanic Women in Rural California. *JOGNN - J Obstet*

- Gynecol Neonatal Nurs.* 2018;47(1):23-31. doi:10.1016/j.jogn.2017.11.012
33. Mahishale A, Bhatt J. Comparison of level of depression among mothers with lower segment cesarean section and vaginal delivery: A cross-sectional study. *J Sci Soc.* 2017;44(1):15. doi:10.4103/0974-5009.202547
34. Malik FR, Malik BB, Irfan M. Comparison of postnatal depression in women following normal vaginal delivery and caesarean section: A pilot study. *J Postgrad Med Inst.* 2015;29(1):34-37.
35. Park JH, Karmaus W, Zhang H. Prevalence of and risk factors for depressive symptoms in Korean women throughout pregnancy and in postpartum period. *Asian Nurs Res (Korean Soc Nurs Sci).* 2015;9(3):219-225. doi:10.1016/j.anr.2015.03.004
36. Goecke TW, Voigt F, Faschingbauer F, Spangler G, Beckmann MW, Beetz A. The association of prenatal attachment and perinatal factors with pre- and postpartum depression in first-time mothers. *Arch Gynecol Obstet.* 2012;286(2):309-316. doi:10.1007/s00404-012-2286-6
37. Deng AW, Xiong RB, Jiang TT, Luo YP, Chen WZ. Prevalence and risk factors of postpartum depression in a population-based sample of women in Tangxia Community, Guangzhou. *Asian Pac J Trop Med.* 2014;7(3):244-249. doi:10.1016/S1995-7645(14)60030-4
38. Gupta S, Kishore J, Mala YM, Ramji S, Aggarwal R. Postpartum depression in North Indian women: Prevalence and risk factors. *J Obstet Gynecol India.* 2013;63(4):223-229. doi:10.1007/s13224-013-0399-x
39. Nayak M. Prevalence & related factors to postnatal depression: A comparison between NVD & LSCS mothers. *Int J Res Pharm Sci.* 2020;11(2):2228-2233.



doi:10.26452/ijrps.v11i2.2175

40. Savarimuthu RJS, Ezhilarasu P, Charles H, Antonisamy B, Kurian S, Jacob KS. Postpartum depression in the community: A qualitative study from rural south India. *Int J Soc Psychiatry*. 2010;56(1):94-102. doi:10.1177/0020764008097756

41. Upadhyay R, Chowdhury R, Salehi A, et al. Postpartum depression in india: A systematic review and meta-analysis. *Bull World Health Organ*. 2017;95(10):706-717. doi:10.2471/BLT.17.192237 LK - <http://vb3lk7eb4t.search.serialssolutions.com?sid=EMBASE&issn=15640604&id=doi:10.2471%2FBLT.17.192237&atitle=Postpartum+depression+in+india%3A+A+systematic+review+and+meta-analysis&stitle=Bull.+WHO&title=Bulletin+of+the+World+Health+Organization&volume=95&issue=10&spage=706&epage=717&aulast=Upadhyay&aufirst=Ravi+Prakash&auinit=R.P.&aufull=Upadhyay+R.P.&coden=BWHOA&isbn=&pages=706-717&date=2017&auinitl=R&auinitm=P>.

42. Hahn-Holbrook J, Cornwell-Hinrichs T, Anaya I. Economic and Health Predictors of National Postpartum Depression Prevalence: A Systematic Review, Meta-analysis, and Meta-Regression of 291 Studies from 56 Countries. *Front Psychiatry*. 2018;8:1-23. doi:10.3389/fpsy.2017.00248

43. Maharashtra D of E and SPDG of. *Economic Survey of Maharashtra 2019-20.*; 2020.

44. Eisenach J c, Pan PH, Smiley R, Lavandhomme P, Landau R, Houle TT. Severity of Acute Pain After Childbirth, but not Type of Delivery, Predicts Persistent Pain and Postpartum Derpession. *Pain*. 2008;140(1):78-94. doi:10.1038/jid.2014.371

45. Arifin S, Cheyne H, Maxwell M. Review of the prevalence of postnatal depression across

- cultures. *AIMS Public Heal*. 2018;5(3):260-295. doi:10.3934/publichealth.2018.3.260
46. Klainin P, Gordon D. International Journal of Nursing Studies Postpartum depression in Asian cultures : A literature review. *Int J Nurs Stud*. 2009;46:1355-1373. doi:10.1016/j.ijnurstu.2009.02.012
47. Taherifard P, Delpisheh A, Shirali R, Afkhamzadeh A, Veisani Y. Socioeconomic, Psychiatric and Materiality Determinants and Risk of Postpartum Depression in Border City of Ilam, Western Iran. *Depress Res Treat*. 2013;2013. doi:10.1155/2013/653471
48. Arbabi M, Taghizadeh Z. Mode of Delivery and Post-partum Depression: A Cohort Study. *J Womens Heal Care*. 2016;05(01):1-5. doi:10.4172/2167-0420.1000303
49. Moameri H, Ostadghaderi M, Khatooni E, Doosti-Irani A. Association of postpartum depression and cesarean section: A systematic review and meta-analysis. *Clin Epidemiol Glob Heal*. 2019;7(3):471-480. doi:10.1016/j.cegh.2019.02.009
50. Xu H, Ding Y, Ma Y, Xin X, Zhang D. Cesarean section and risk of postpartum depression: A meta-analysis. *J Psychosom Res*. 2017;97:118-126. doi:10.1016/j.jpsychores.2017.04.016
51. Grivell RM, Dodd JM. Short- and long-term outcomes after cesarean section. *Expert Rev Obstet Gynecol*. 2011;6(2):205-215. doi:10.1586/eog.11.5
52. Gupta M, Saini V. Cesarean section: Mortality and morbidity. *J Clin Diagnostic Res*. 2018;12(9):QE01-QE06. doi:10.7860/JCDR/2018/37034.11994

**Table 1** Socio-demographic Characteristics of Study Participants (n=3,112), India, 2017-18

Characteristics		LSCS (n=1556)	Vaginal (n=1556)	Total	Chi
Age group	≤ 19	83 (5.38)	117 (7.59)	200 (6.48)	36.99 ( $<0.001$ )**
	20 – 24	809 (52.40)	907 (58.82)	1716 (55.61)	
	25 – 29	485 (31.41)	415 (26.91)	900 (29.16)	
	30 – 34	133 (8.61)	93 (6.03)	226 (7.32)	
	> 35	34 (2.20)	10 (0.65)	44 (1.43)	
	Data not available	12	14	26	
Parity	1 <sup>st</sup> Para	632 (42.16)	638 (42.85)	1270 (42.50)	0.7 (0.87)
	2 <sup>nd</sup> Para	647 (43.16)	640 (42.98)	1287 (43.07)	
	3 <sup>rd</sup> Para	207 (13.81)	195 (13.10)	402 (13.45)	
	Multipara	13 (0.87)	16 (1.07)	29 (0.97)	
	Data not available	57	67	124	
Annual income in Indian Rupees (1 Rs. =0.013 \$)	Less than 14,999	411 (28.88)	381 (27.27)	792 (28.09)	8.53 (0.01)*
	15,000-99,999	933 (65.57)	967 (69.22)	1900 (67.38)	
	100,000+	79 (5.55)	49 (3.51)	128 (4.54)	
	Data not available@	133	159	292	
Education	Graduate/higher	242 (15.76)	153 (10.24)	395 (13.04)	37.74 ( $<0.001$ )**
	12 <sup>th</sup> /Diploma after 10 <sup>th</sup>	422 (27.47)	356 (23.83)	778 (25.68)	
	High school (8-10 std.)	371 (24.15)	382 (25.57)	753 (24.85)	
	Middle school (5-7 std.)	246 (16.02)	304 (20.35)	550 (18.15)	
	Primary (1-4 std.)	154 (10.03)	159 (10.64)	313 (10.33)	
	Illiterate	101 (6.58)	140 (9.37)	241 (7.95)	
Occupation	Data not available	20	62	82	3.63 (0.72)
	Profession	29 (1.88)	17 (1.13)	46 (1.51)	
	Semi-profession	12 (0.78)	14 (0.93)	26 (0.85)	
	Clerk, shop-owner, farmer	38 (2.47)	38 (2.52)	76 (2.50)	
	Skilled worker	33 (2.14)	32 (2.13)	65 (2.13)	
	Semi-skilled worker	20 (1.30)	24 (1.59)	44 (1.44)	
	Unskilled worker	32 (2.08)	29 (1.93)	61 (2.00)	
	Unemployed	1377 (89.36)	1351 (89.77)	2728 (89.56)	
	Data not available	15	51	65	

@ Includes not having ration card, hence no information about income

**Table 2** Comparison of postpartum depression with the mode of delivery, India, 2017-18

EPDS	Mode of Delivery		Total (%)	Chi Square (p)
	LSCS (%)	Vaginal (%)		
0	786 (55.20)	812 (57.71)	1598 (56.4)	8.22 (0.04)*
1 – 5	485 (34.06)	488 (34.68)	973 (34.37)	
6 – 9	99 (6.95)	74 (5.26)	173 (6.11)	
≥10	54 (3.79)	33 (2.35)	87 (3.07)	
Total	1424	1407	2831	

\* Significant;  $p < 0.05$

SSC=Secondary School Certificate, LSCS=Lower Segment Caesarean Section

**Table 3** Postpartum depression scores and type of LSCS, India, 2017-18

EPDS	Mode of Delivery		Total	Chi square (p)
	Em. LSCS (%)	El. LSCS (%)		
0	605(57.51)	151(49.35)	756 (55.67)	11.94  (0.01)*
1 – 5	335 (31.84)	130 (42.48)	465 (34.24)	
6 – 9	77 (7.32)	15 (4.90)	92 (6.77)	
≥10	35 (3.33)	10 (3.27)	45 (3.31)	
Total	1052	306	1358	

\* Significant; p<0.05

Em.= Emergency

**Table 4** Multivariate analysis of risk factors for PPD, India, 2017-18

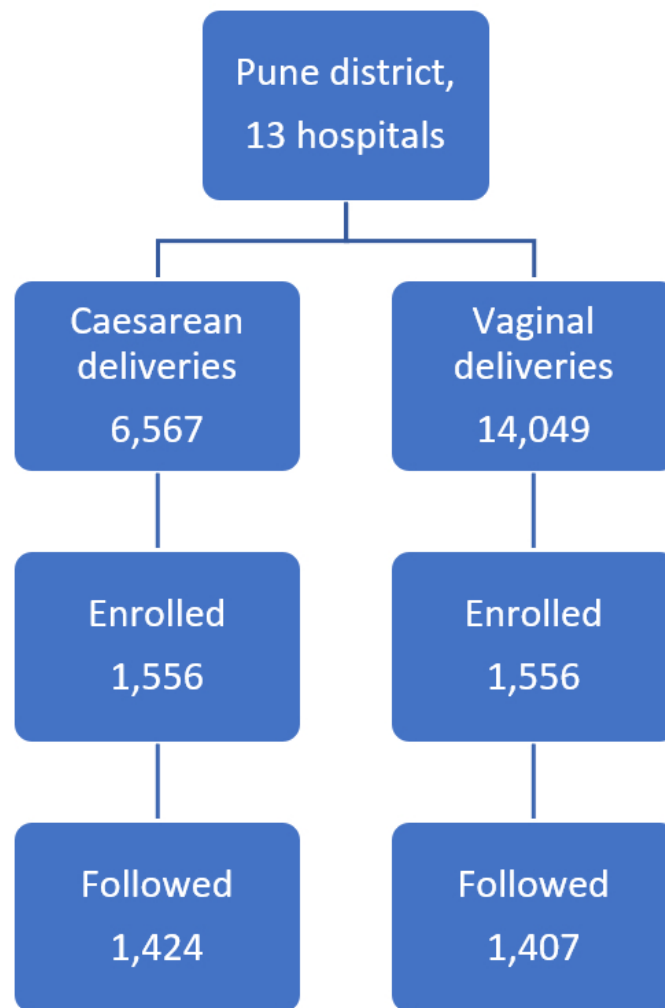
		Score		Total	Adj. Odds Ratio	p
		≥10	<10			
Age	≥25	25	1048	1073	0.48(0.27-0.83)	0.01*
	<25	62	1673	1735	1	
Income	Non-BPL	62	1777	1839	1.60(0.91-2.83)	0.11
	BPL	19	704	723	1	
Education	>SSC	31	1046	1077	0.80(0.49-1.31)	0.37
	≤SSC	54	1628	1682	1	
Occupation	Employed	8	281	289	1.11(0.50-2.47)	0.80
	Unemployed	77	2412	2489	1	
Sex of new born	Male	43	1354	1397	0.96(0.60-1.52)	0.85
	Female	42	1245	1287	1	
Mode of Delivery	LSCS	54	1370	1424	1.86(1.14-3.03)	0.01
	Vaginal	33	1374	1407	1	
Parity	>2	12	385	397	1.00(0.50-2.0)	0.99*
	≤2	72	2251	2323	1	

\* Significant; p&lt;0.05

**Figure 1** Block and type wise participating hospitals in Pune, India, 2017-18**Figure 2** Women delivered and followed in Pune, India, 2017-18



**Figure 1** Block and type wise participating hospitals in Pune, India, 2017-18



**Figure 2** Women delivered and followed in Pune, India, 2017-18



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STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found
<b>Introduction</b>		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
<b>Methods</b>		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses
<b>Results</b>		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest
Outcome data	15*	Report numbers of outcome events or summary measures
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses

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<b>Discussion</b>		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
<b>Other information</b>		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Comparison of postpartum depression at six weeks among caesarean and vaginally delivered women in Pune District, India

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Secondary Subject Heading:	Reproductive medicine, Mental health
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**Comparison of postpartum depression at six weeks among caesarean and vaginally delivered women in Pune District, India**

Dr. Prakash Prabhakar Rao Doke,<sup>1</sup>

Dr. Varsha Mahesh Vaidya,<sup>1</sup>

Dr. Arvinder Pal Singh Narula,<sup>1\*</sup>

Dr. Manjiri Chaitanya Datar,

Dr. Archana Vasantro Patil,<sup>2</sup>

Dr. Tushar Madhav Panchanadikar,<sup>1</sup>

Dr. Girija Narendra Wagh,<sup>1</sup>

<sup>1</sup>Bharati Vidyapeeth Deemed University Medical College, Pune, India

<sup>2</sup> Directorate of Health Services, Government of Maharashtra, Pune, India

\* Corresponding author

Dr. Arvinder Pal Singh Narula,

Address: Department of Community Medicine, Bharati Vidyapeeth Deemed University Medical College, Satara Road, Dhanakawadi, Pune, India, 411043

Email: arvindernarula@rediffmail.com

Telephone: +918805984393

Fax: +9102024372175

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**Comparison of postpartum depression at six weeks among caesarean and vaginally delivered women in Pune District, India**

**ABSTRACT**

**Objectives** To compare the proportion of postpartum depression at six weeks among caesarean delivered and vaginally delivered women and to assess its association with some socio-demographic factors.

**Design** It was a descriptive comparative study with prospective enrolment. We followed the enrolled women and assessed them for postpartum depression (PPD) six weeks after delivery.

**Setting** We conducted the study in Pune district, India from July 2017 to December 2018. The study sites were all non-teaching government hospitals performing five or more caesarean sections per month and two teaching hospitals one government, and one private.

**Participants**

We included participant women who have undergone caesarean section in the participating hospitals and residents of Pune district in the study group. The women delivered vaginally and matching in age and parity were included in the comparison group. We followed 1,556 women in each group.

**Main outcome measures** Edinburgh Postnatal Depression Scale (EPDS) score 10 or more for each woman was the primary outcome. Chi-square test and multivariable binary logistic regression were performed to assess the effect of delivery mode on postpartum depression.

**Results** The proportion of postpartum depression was 3.79% among caesarean delivered women and 2.35% among vaginally delivered women at six weeks (Chi square=4.50; p=0.03). The

adjusted odds ratio was 1.86 (95% CI=1.14 to 3.03). Age less than 25 years had higher risk of postpartum depression. The adjusted odds ratio was 2.10 (95% CI =1.21-3.65). The study did not observe any association between postpartum depression and income, education, occupation or sex of the new-born child.

**Conclusions** We conclude that young women particularly caesarean delivered should be screened six weeks after delivery.

**Keywords:** Postpartum Depression; Prevalence; Caesarean delivery; Socio-demographic characteristics; Gender

### **Strengths and limitations of this study**

- ▶ The present study is a large multi-site study.
- ▶ Trained health care workers assessed the women six weeks postpartum.
- ▶ The study asserted that young and caesarean delivered women are having higher risk of PPD.
- ▶ The authors didn't assess or ask history of postpartum depression during pregnancy or immediately after delivery.
- ▶ We did not include a non-teaching private hospital.



**Comparison of postpartum depression at six weeks among caesarean and vaginally delivered women in Pune District, India**

**INTRODUCTION**

**Background**

Women face major depression 1.6 to 2.6 times more than men.<sup>1</sup> This difference is most apparent in the postpartum period. The American Psychiatric Association’s Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5), defines postpartum depression specifying the period as; ‘most recent episode of major depression if onset of mood symptoms occurs during pregnancy or in the four weeks following delivery’.<sup>2</sup> To assess the postpartum depression (PPD), Edinburgh Postnatal Depression Scale (EPDS) is the most commonly used tool. The prevalence is influenced by the tool used and time of assessment after birth. Most psychiatrists and obstetricians consider the period up to one year,<sup>3–10</sup> but the symptoms may persist longer.<sup>11</sup> Various secondary data analyses have estimated that globally about 10-15% women suffer from PPD.<sup>12–14</sup> This common complication of childbearing is a disabling but treatable mental disorder. The consequences of PPD are related to the mother, the child, and mother-child interactions. The first category includes a woman’s social relationship including with her husband. Severe malnutrition, health problems like diarrhea, language and cognitive development among the children, represent the second category. Mother-to-child bonding, breastfeeding problems represent the third category.<sup>1,15,16</sup> Studies identifying its risk factors are fewer than studies estimating incidence/prevalence.<sup>3,4,17,18</sup> The risk factors are classified as socio-economical and biological. The risk factors may be present during pregnancy or appear after childbirth.<sup>1,11</sup>

Although mode of delivery is one of the recognized risk factors, the psychiatric risk factors receive more attention. Some studies have shown a higher risk of postpartum depression after cesarean section,<sup>19,20</sup> but some studies did not.<sup>21,22</sup> Most of these studies are small and from a single institution. On the other hand, some large studies did not include the mode of delivery as a risk factor.<sup>17,23</sup> The woman undergoing cesarean section has mental stress due to exposure to operation and expenditure incurred. Additionally, the feeling of guilt exists, as the women consider caesarean mode of delivery as a failure on the part of the mother to endure pain. Such a guilt also contributes to development of PPD. Hence postpartum depression is more likely to occur among cesarean delivered women than vaginally delivered. We perceived the need for a comparative study because globally the proportion of cesarean is increasing and absence of large studies particularly from India. Additionally, the authors considered the sex of the new-born as one variable because some Indian studies have observed that the birth of a girl child is also a risk for PPD.<sup>20,24,25</sup> In India, despite the launch of the National Mental Health Programme in 1982, maternal mental is not given due attention.

## Objectives

1. To compare the proportion of PPD at six weeks between cesarean delivered and vaginally delivered women, in Pune District
2. To assess its association with socio-economic factors including the sex of the new-born.

## MATERIAL AND METHODS

### Study Design

It was an observational and descriptive study comparing PPD six weeks after delivery among women who have undergone caesarean and vaginal delivery.

### Settings

Pune District is the second populous district in Maharashtra State, and fourth in India, having a population of 9,429,408, as per the last census 2011. Pune Municipal Corporation together with Pimpri Chinchwad Municipal Corporation constitutes 51.46% of the district population. The female to male (per 1,000) ratio is 915 and the female literacy rate is 81.05%. We included all nine non-teaching government hospitals conducting at least five cesareans per month, one government teaching hospital, and one private teaching hospital (the nodal site). The authors conducted this study in collaboration with the Directorate of Health Services Government of Maharashtra. The selected hospitals included five tertiary care hospitals (two medical college hospitals, one district hospital, two municipal corporation hospitals), six sub-district hospitals (includes one women's hospital), and two community health centres from different places. Figure 1 gives the details.

**Period**

The study duration was from 1<sup>st</sup> July 2017 to 31<sup>st</sup> December 2018 including the enrolment period from 1<sup>st</sup> September 2017 to 31<sup>st</sup> March 2018.

**Participants**

A woman who was a resident of the Pune district and ready to come for follow-up was eligible for inclusion. We excluded a woman who does not know even one language out of English, Marathi, or Hindi; or has a critical illness needing immediate transfer to a higher institution (non-study site); or has a severe psychiatric illness (unable to understand and respond). All women who had undergone caesarean section during the enrolment period were included as ‘study participants’ within 48 hours after caesarean section. After enrolling a woman in the study group, we included the first vaginally delivered woman matching age ( $\pm$  2.5 years) and parity in the comparison group. Figure 2 depicts the flowchart of enrolment of participants.

## Follow-up

The research team requested all women for follow-up at six weeks (coincident with the initiation of immunization of the child) at the hospitals. The research team frequently reminded the women on the phone about their due visit. We invited the women not attending the hospital for specially organized follow-up camps. Health care workers visited the houses of the women who did not participate in the institution or camp and requested them to come for follow-up. A social worker conducted a telephonic interview of the women who neither visited the institution nor follow-up camp. The follow-up was started on 16<sup>th</sup> October 2017 and stopped on 30<sup>th</sup> June 2018. We advised all women suspected of having postpartum depression to consult a psychiatrist

## Data collection

The authors notified a pair consisting of an obstetrician and the in-charge nurse as the 'site coordinator team' from each participant hospital. But, in the medical college hospitals, we formed unit-wise teams. The Department of Community Medicine and Psychiatry trained them and the research team (one coordinator who was a public health specialist and two medico-social workers). That one-day training included an introduction to the study, collection of initial information, follow-up and monitoring, and filling the EPDS format. Trainees practiced filling of EPDS format interviewing colleague as a delivered woman. Women were enrolled before discharge (48 hours to seven days after delivery). A site coordinator team member filled the initial part of the format by collecting information from records and remaining part by face-to-face interviews. They again interviewed the women during follow-up visits, and responses were recorded on the printed EPDS format. A psychiatrist assessed the women visiting the nodal site (delivered in that institution and some women from nearby areas). The research coordinator and the two medico-social workers supervised and coordinated follow-up and data collection.

Authors, along with the research coordinator, regularly visited all the sites. We collected the filled-up forms from the rural areas monthly or during visits, and weekly from corporation areas. The research coordinator scrutinized the forms and contacted the women on the phone if needed.

**Variables**

The site coordinator collected the information about the mode of delivery (including emergency or elective caesarean), age, parity, education, family income, and occupation. We decided the socioeconomic class based on Kuppuswamy's classification, which uses the occupation and education of the head of the family and the family's monthly income.<sup>26</sup> We used colour of the ration card as a proxy of income. The government has provided yellow, orange, and white colour ration cards to families having annual income less than ₹.15,000, ₹.15,000 to ₹.99,999, and ₹.100,000 or above respectively (1 ₹ =0.013 \$). Yellow ration card holders are considered as Below Poverty Line (BPL) and are eligible for benefits under some schemes.

We calculated the depression score for each woman using EPDS that Cox JL developed in 1987.<sup>27</sup> It is a '10 item' scale assessing various aspects of depression on a week recall of mood and feelings. The interviewing persons ensured a response for each item. Each item is scored on a severity scale ranging from 0 to 3, thus the possible highest total score is 30.

**Data sources/measurement**

The source of data was the case report form. The interview schedule comprised of information about the socioeconomic characteristics of the participants and detailed obstetric history. The site coordinator assessed the woman during the follow-up visit at six weeks for PPD using EPDS, which was validated and translated into Marathi (local language). The data entry operator entered the information on the Excel Sheet. Then the total score of each woman was calculated. We

considered the most commonly used cut-off score of  $\geq 10$  of a woman to identify as having postpartum depression.

### **Bias**

The translated EPDS format was not having any identification marker about the mode of delivery and thus the assessors were blinded to the mode of delivery.

### **Study Size**

To capture a PPD difference of 7.6% between caesarean section and vaginal delivery,<sup>10</sup> with a 95% confidence and 80% power, the sample size required was 228 in each group. However, this study was a part of a larger study in which we compared puerperal infection. Based on available rates of puerperal infection, 1,556 participants in each group were enrolled and followed.

### **Statistical methods**

Descriptive statistics as percentages for the categorical variables were tabulated for selected predictors. We analysed the data using, 'Statistical Package for the Social Science' (SPSS) Version 25.0. Chi-square test with Yates's correction was applied to assess the association between PPD and socio-demographic and obstetric parameters of the participants. The authors calculated the adjusted odds ratio using multivariable binary logistic regression. Division of age in two groups was based on observations, income on entitlement for government schemes (BPL), education on years of schooling, and occupation on employed or not. P-value  $<0.05$  was considered to be statistically significant.

### **Patient and Public Involvement**

Participant women were not involved in developing the study design but they were given all information about the study and referred whenever necessary. Officers from health department were involved in evolving study design.

**RESULTS**

During the enrolment period in the selected 13 hospitals, 6,567 cesareans and 14,049 vaginal deliveries were conducted. About 40% of cesarean delivered women were not eligible due to residence outside Pune District and 40% were unwilling to come for follow-up. Around 15% were excluded due to the language barrier and about 5% were critically ill or having a psychiatric problem.

The number of mothers contacted directly during a hospital visit, through camps and phone calls was roughly 50%, 30%, and 20% respectively.

We followed 2,831 women (90.97%) at six weeks. The details about delivered, enrolled, and followed women are given in figure 2. Illegible handwriting plus the inability to confirm the contents on the phone and unfilled sections were the common reasons for incomplete data. Some women were not available on the phone and some migrated to other districts.

**Socio-demographic characteristics**

Out of 3,112 participants, the data from the varied number of women could not be obtained for certain variables. About 68% of participants were from Municipal Corporation areas. Table 1 gives only the socio-demographic characteristics of the participants by mode of delivery.

The mean age of participants was 23.96 ( $\pm 3.72$ ) years. The younger age group up to 25 years was the dividing line. The proportions of women in younger age groups were lesser among caesarean delivered than vaginally delivered. The overall proportion of the first para plus 2nd para was 85.57%, and there was no difference between the two groups. The proportion of passing 10<sup>th</sup> standard among caesarean was 43.22%, while it was 34.07% among vaginally delivered.

### Postpartum Depression at six weeks

We could not interview 8.48% and 9.58% of participants from the caesarean and comparison group, respectively. The proportion of postpartum depression having an EPDS score of 10 or more was 3.79% among caesarean and 2.35% among vaginally delivered women (Chi-square=4.50; p=0.03). Chi-square test was applied to the overall (disregarding mode of delivery) distribution of the variables given in table 1 and EPDS score less than ten and >10, showed no association between socio-demographic characteristics and EPDS. The details about the mode of delivery and EPDS score group are given in table 2, which shows that the proportion of caesarean delivered women who scored six and above was consistently higher than that of vaginally delivered women. This consistency was not observed in the type of caesarean section. Hence, we separately applied two by two chi-square test with Yate's correction making two groups as given in table 2. There was no significant difference between the proportion of women having EPDS score >10 among women undergone emergency and elective caesarean. The sex of the new-born child had no association with PPD (Chi-square=0.04; p=0.87)

The adjusted odds ratios of various factors for EPDS score ten or more calculated using multivariable binary logistic regression are given in table 3. We observed a significantly high odds ratio (1.86; 95% CI=1.14-3.03), indicating almost double the risk of PPD among caesarean delivered women. Similarly, the young mothers less than 25 years also had a significantly high odds ratio (2.10; CI=1.21-3.65), indicating more than double the risk of PPD than elder mothers. The rest of the factors did not have any association with EPDS score.

### Discussion



The authors observed a prevalence of PPD less than four in Pune district. The study observed that odds of having PPD are higher among caesarean delivered women than vaginally delivered women. Women aged less than 25 years also have higher odds of having PPD.

About effect of mode of delivery, even WHO is not consistent. The mode of delivery initially was not included in the risk factor list,<sup>11</sup> later indicated that caesarean delivery is associated with a higher risk for PPD.<sup>1</sup> Some studies, including a review study, did not consider the effect of the mode of delivery.<sup>17,28</sup> With the increasing number of caesarean sections, ascertaining its effect on PPD is necessary. But there is no concordance between the results of various studies. Some studies did not show an association between the mode of delivery and PPD.<sup>21,22,29–32</sup> In some studies, an association was observed but not significant or disappeared after adjusting for confounders.<sup>5,18,20,33–35</sup> One reason for the non-significant difference is the inadequacy of sample size. Many studies showed a significantly higher increased risk due to caesarean section.<sup>36–38</sup> All four comparative studies involving 50 to 100 participants in each group observed a higher risk of PPD among caesarean delivered women.<sup>19,36,39,40</sup> Two meta-analyses clearly showed increased risk due to caesarean section.<sup>41,42</sup> But most of the studies were small and from a single institution. Only two studies reported a higher risk with vaginal delivery.<sup>5,10</sup> The reasons for higher PPD among vaginally may be related to a woman's pain during and after episiotomy, repair of tear or forceps application, etc.<sup>29</sup> The higher risk of PPD due to caesarean section can be consequent to postpartum complications, including infection, haemorrhage, intra-operative complications, blood transfusion, more extended hospital stay, and higher expenditure.<sup>43,44</sup> Secondly, women undergoing non-vaginal delivery can have more probability of self-reported symptoms.

Contrary to the present study, the range of PPD observed in India has a higher range from 7.5 to 31.4%.<sup>3,4,10,14,15,19,21,22,24,25,30,31,36,40,45,46</sup> A meta-analysis of Indian studies observed a range of 3 to 47%; concluded that the average proportion of PPD was 19%.<sup>14</sup> The meta-analysis and the references quoted in the present study pointed out the higher prevalence in South India. The same meta-analysis, an upward trend, but the authors did not observe any trend in the occurrence of PPD while analysing the referred studies in this article. The difference can be due to two reasons; firstly, we have referred to fewer articles, and secondly, they are relatively recent. The meta-analysis also observed that the prevalence was higher in urban areas than rural areas, and a higher proportion was reported from studies in hospital settings than in community settings.<sup>14</sup> Our estimated prevalence of PPD is on the lower side. The economic and health indicators affect the PPD.<sup>47</sup> Pune District has better health and economic indicators.<sup>48</sup> The assessors were not psychiatrists or psychologists; some responses were through phone calls. But both these practices are documented.

The proportion of PPD reported during the last two decades in various countries was from 5.3% in Turkey to 42.6% in California, USA.<sup>7,10,20,22,29,32,35,38,49</sup> WHO had quoted studies wherein the PPD ranged from 10% in Uganda to 40% in Pakistan.<sup>1</sup> In another report reviewing maternal mental health, specifically in low and middle-income countries, the prevalence ranged from 10.7% in Nigeria to 50% in Guyana.<sup>11</sup> In a global review, minimum PPD (4%) from Japan and high PPD (63.9%) in America were noted.<sup>12</sup> A review from Asian countries pointed out that Malaysia had the lowest PPD (3.5%) and Pakistan had the highest (63.3%).<sup>13</sup> The lower prevalence in our study is not an outlier.

For better supervision and thereby assurance of quality, we limited the number of participating hospitals by applying the selection criterion. The history of PPD during pregnancy

and psycho-social familial relations was also not asked. But we assume whatever a small proportion of women have such a history, the proportion ought to be similar in both the groups. Although the American Psychiatric Association included symptoms occurring within four weeks of delivery under postpartum depression, the study considered the conventional obstetric postpartum period of six weeks. In India, postnatal visits are less frequent than ante-natal visits. During the postnatal visit, an assessment for PPD is not carried out. Due to socio-cultural traditions, women usually do not move out of the home for about six weeks. The women visit the institutions to initiate vaccination for their children and, hence, we planned assessment at that time. Therefore, the number of lost follow-ups was less than 10%. Although our study was primarily confined to the government hospitals, any private hospital providing immunization services can start assessing the women.

Apart from socio-cultural and biological factors, the tool of assessment is also an important determinant. The most used tool is EPDS which is in vogue since the 1980s.<sup>12</sup> There ought to be inconsistency when different tools are used. The accepted cut-off point also determines it. One report had quoted studies demonstrating the effects of the assessment system, changing cut-off points, and time of assessment.<sup>11</sup> Various investigators have used EPDS cut-off points from 7 to 13. The present study used the EPDS tool to assess PPD, and considered the cut-off point as ten and above. Many studies considered a higher score of 12 or 13 as a cut-off point.<sup>6,7,8,18,20,25,30–32,37,49,50</sup> But several studies have considered a cut-off of 10 points like the present study.<sup>3,4,10,15,28,36,38,39</sup> A systematic review has estimated sensitivity of 0.85 and specificity of 0.84 for cut-off of score ten.<sup>51</sup> Lower cut-off points of nine,<sup>11,52</sup> or seven are also used.<sup>34</sup> EPDS is not a diagnostic tool, but it is a screening tool. An EPDS score of six and above had already been used in one country and had 100% sensitivity and is quoted in a document by WHO.<sup>11</sup> Lower the

cut-off point higher is the sensitivity, but specificity reduces.<sup>51</sup> But screening tests are meant to capture maximum suspected patients for further evaluation.

The time of the evaluation is an important factor. The studies have been conducted as early as within three days to one year.<sup>6,8,15,38</sup> An inexperienced person may classify maternal blues as PPD, which has a similar presentation and appears within few days of delivery. It is observed that the prevalence of PPD decreases with time.<sup>49</sup> The meta-analysis study in India observed that a pooled prevalence of 22% was reduced to 19% after deducting studies assessing PPD within two weeks.<sup>14</sup>

The association of PPD with age is inconsistent; some did not show any association with PPD,<sup>4,10,18,52</sup> but some did.<sup>3,46</sup> Few studies have reported that increasing age heightens the chances of getting PPD, particularly after 30 years.<sup>6,25,30</sup> The pooled prevalence of PPD was estimated as 20% and 21% when studies with mean maternal age of  $\leq 25$  years and  $> 25$  years, but the difference was not significant.<sup>14</sup> But chances are very high among women less than 20 years.<sup>46</sup> The present study confirms that women less than 25 years have almost double risk. The higher risk may be bi-polar; young<sup>46</sup> and middle-aged are at increased risk.<sup>6,25,30</sup> Lower prevalence among elder mothers can reflect better psycho-social adjustment within the family by 25 years of age. The present study did not find any association between income and PPD. The association between PPD and income is inconsistent.<sup>18,53</sup> We did not observe any association consonant with one study<sup>4</sup> but some studies observed association.<sup>15,30</sup> In Indian society, if the woman has one or more girls, the birth of a male child is preferred. The woman is blamed or made to feel guilty for giving birth to a female child. Many studies reported a higher prevalence of PPD after the birth of a female child.<sup>20,25,34</sup> Like the present study few studies did not observe such association.<sup>8,49</sup> The problem is state or district-specific. Additionally, in the last two

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decades, extensive efforts have been taken by the government and non-governmental agencies to create awareness about gender bias.

The comparison between elective and emergency caesarean is full of variations. There was no difference between an emergency and elective caesarean section<sup>18</sup>. Some studies reported higher risk with elective caesareans,<sup>20,37</sup> while one study reported contradictory findings.<sup>42</sup> A higher risk of PPD after an emergency caesarean section is a reflection of acute stress reactions.<sup>1</sup>

Even this low prevalence observed in the present study amounts to about 50,000 cases per year in the state. If PPD is untreated, the new-born and the whole family may face some consequences. Maximum women may be screened by applying sensitive criteria by paramedical persons before referral to a psychiatrist, as there is a shortage of psychiatrists. We suggest further research involving assessment trained paramedical, in the rural areas, at that most feasible period is six weeks and with a robust referral system to alleviate the common problem of delivered women.

We did not include private hospitals and the time of onset of the symptoms. The assessment was done only at six weeks. History of psychological problems and family violence etc., was not asked. A psychiatrist did not assess all the women. Complete blinding was not possible as many interviewers knew the women. Some interviews were telephonic. The authors did not separately analyse data by mode of collection or person collecting. The overall prevalence may not apply to the general population because the proportion of caesarean is less than 50%.

The present study is a multisite study involving a large number of participants. It is the second largest one among all the referred studies from the last two decades.<sup>35</sup> It is the largest

Indian study covering a large district. Trained health care workers assessed the women. Lost to follow-up women are less than 10%.

## Conclusions

The study confirmed younger age and caesarean are risk factors. In all hospitals at six weeks postpartum, universal assessment of delivered women, particularly young and caesarean delivered, screening using EPDS score should be initiated through nurses or medico-social workers. The sensitivity and specificity studies using six or more EPDS scores need consideration.

**Contributors** PPD was involved in planning, data analysis and writing manuscript. VMV and APSN were involved in planning and supervision. MCD was involved in training and assessment. AVP was involved in monitoring follow up. TMP was involved in supervision, monitoring and collection of data. GNW was involved in supervision and collection of data. All the authors contributed to writing manuscript and approved the manuscript.

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**Competing interests** All authors declare that competing interests are nil.

**Consent for participation and publication** The authors obtained consent for participation and publication from all the participants.

**Ethics approval** The study was approved by the Institutional Ethics Committee (DCGI Regd. No. ECR/313/Inst/MH/2013/RR-16) vide letter number IEC/2017/34 Date: 31Aug 2017.

**Data sharing statement** All the data will be shared on reasonable request to corresponding author.

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**REFERENCES**

1. WHO and UNFPA. *Mental Health Aspects of Women’s Reproductive Health.*; 2009.
2. American Psychiatric Association. *Diagnostic and Statistical Manual Fo Mental Disorder DSM-5.* Fifth. American Psychiatric Publishing; 2013.
3. Agarwala A, Arathi Rao P, Narayanan P. Prevalence and predictors of postpartum depression among mothers in the rural areas of Udupi Taluk, Karnataka, India: A cross-sectional study. *Clin Epidemiol Glob Heal.* 2019;7(3):342-345.  
doi:10.1016/j.cegh.2018.08.009
4. Gaikwad S, Mundada V, Dhande V, Doibale M. Assessment of postnatal depression and some associated risk factors among mothers attending the immunisation outpatient department in a tertiary health care centre : a cross sectional study. *Int J Community Med Public Heal.* 2019;6(10):4412-4416.
5. Chaaya M, Campbell OMR, El Kak F, Shaar D, Harb H, Kaddour A. Postpartum depression: Prevalence and determinants in Lebanon. *Arch Womens Ment Health.*

- 2002;5(2):65-72. doi:10.1007/s00737-002-0140-8
6. Inandi T, Elci OC, Ozturk A, Egri M, Polat A, Sahin TK. Risk factors for depression in postnatal first year, in eastern Turkey. *Int J Epidemiol*. 2002;31(6):1201-1207. doi:10.1093/ije/31.6.1201
7. Kaya L, Cigdem Z. The relationship between mode of delivery and postpartum derpression. *J Heal Educ Promot*. 2019;8(5):1-6. doi:10.4103/jehp.jehp
8. Lagerberg D, Magnusson M. Infant gender and postpartum sadness in the light of region of birth and some other factors: A contribution to the knowledge of postpartum depression. *Arch Womens Ment Health*. 2012;15(2):121-130. doi:10.1007/s00737-012-0265-3
9. Regmi S, Sligl W, Carter D, Grut W, Seear M. A controlled study of postpartum depression among Nepalese women: Validation of the Edinburgh Postpartum Depression Scale in Kathmandu. *Trop Med Int Heal*. 2002;7(4):378-382. doi:10.1046/j.1365-3156.2002.00866.x
10. Shriram V, Shah PB, Anitha RM, BWC S. A community-based study of postpartum depression in rural South India. *Indian J Soc Psychiatry*. 2019;35:64-68. doi:10.4103/ijsp.ijsp\_13\_18
11. WHO and UNFPA. *Maternal Mental Health and Child Health and Development in Low and Middle Income Countries*.; 2008. Accessed June 23, 2020. [https://www.who.int/mental\\_health/prevention/suicide/mmh\\_jan08\\_meeting\\_report.pdf?ua=1](https://www.who.int/mental_health/prevention/suicide/mmh_jan08_meeting_report.pdf?ua=1)
12. Roshaidai Mohd Arifin S, Cheyne H, Maxwell M. Review of the prevalence of postnatal depression across cultures. *AIMS Public Heal*. 2018;5(3):260-295. doi:10.3934/publichealth.2018.3.260



13. Klainin P, Gordon D. International Journal of Nursing Studies Postpartum depression in Asian cultures : A literature review. *Int J Nurs Stud.* 2009;46:1355-1373. doi:10.1016/j.ijnurstu.2009.02.012

14. Upadhyay R, Chowdhury R, Salehi A, et al. Postpartum depression in india: A systematic review and meta-analysis. *Bull World Health Organ.* 2017;95(10):706-717.

15. Amipara T, Baria H, Nayak S. A study on postpartum depression and its association with infant feeding practices and infant nutritional status among mothers attending the anganwadi centers of Valsad district, Gujarat, India. *Indian J Community Med.* 2020;45(3):299. doi:10.4103/ijcm.IJCM\_171\_19

16. Slomian J, Honvo G, Emonts P, Reginster JY, Bruyère O. Consequences of maternal postpartum depression: A systematic review of maternal and infant outcomes. *Women's Heal.* 2019;15. doi:10.1177/1745506519844044

17. Beck CT. Predictors of Postpartum Depression. *Nurs Res.* 2001;50(5):275-285. doi:10.1089/jwh.2014.4824

18. Goker A, Yanikkerem E, Demet MM, Dikayak S, Yildirim Y, Koyuncu FM. Postpartum Depression: Is Mode of Delivery a Risk Factor? *ISRN Obstet Gynecol.* 2012;2012:1-6. doi:10.5402/2012/616759

19. Dinesh P, Raghavan S. A comparative study of prevalence of postnatal depression among subjects with normal and cesarean deliveries. *IAIM.* 2018;5(2):6-11.

20. Johnstone SJ, Boyce PM, Hickey AR, Morris-Yates AD, Harris MG. Obstetric risk factors for postnatal depression in urban and rural community samples. *Aust N Z J Psychiatry.* 2001;35(1):69-74. doi:10.1046/j.1440-1614.2001.00862.x

21. Patel V, Rodrigues M, Nandita DeSouza M. Gender, Poverty, and Postnatal Depression: A

- Study of Mothers in Goa, India. *Am J Psychiatry*. 2002;159:1.
22. Sheela CN, Venkatesh S. Screening for Postnatal Depression in a Tertiary Care Hospital. *J Obstet Gynecol India*. 2016;66(1):72-76. doi:10.1007/s13224-015-0766-x
23. Faisal-Cury A, Menezes PR. Type of delivery is not associated with maternal depression. *Arch Womens Ment Health*. 2019;22(5):631-635. doi:10.1007/s00737-018-0923-1
24. Jain A, Tyagi P, Kaur P, Puliyel J, Sreenivas V. Association of birth of girls with postnatal depression and exclusive breastfeeding: An observational study. *BMJ Open*. 2014;4(6). doi:10.1136/bmjopen-2013-003545
25. Modi VP, Parikh MN, Kartik VS. A Study on Prevalence of Postpartum Depression with Risk Factors. *Ann Indian Psychiatry*. 2018;2(June):27-32. doi:10.4103/aip.aip
26. Wani R. Socioeconomic status scales-modified Kuppaswamy and Udai Pareekh's scale updated for 2019. *J Fam Med Prim Care*. 2019;8(6):1846. doi:10.4103/jfmpe.jfmpe\_288\_19
27. Cox JL, Holden JM, Sagovsky R. Detection of Postnatal Depression: Development of the 10-item Edinburgh Postnatal Depression scale. *Br J Psychiatry*. 1987;150(JUNE):782-786. doi:10.1192/bjp.150.6.782
28. Park JH, Karmaus W, Zhang H. Prevalence of and risk factors for depressive symptoms in Korean women throughout pregnancy and in postpartum period. *Asian Nurs Res (Korean Soc Nurs Sci)*. 2015;9(3):219-225. doi:10.1016/j.anr.2015.03.004
29. Eisenach J c, Pan PH, Smiley R, Lavandhomme P, Landau R, Houle TT. Severity of Acute Pain After Childbirth, but not Type of Delivery, Predicts Persistent Pain and Postpartum Derpession. *Pain*. 2008;140(1):78-94. doi:10.1038/jid.2014.371
30. Saldanha D, Rathi N, Bal H, Chaudhari B. Incidence and evaluation of factors

contributing towards postpartum depression. *Med Jpurnal Dr DY Patil Univ.* 2014;7(1102):309-316. doi:10.4103/0975-2870.128972

31. Shivalli S, Gururaj N. Postnatal depression among rural women in south India: Do socio-demographic, obstetric and pregnancy outcome have a role to play? *PLoS One.* 2015;10(4). doi:10.1371/journal.pone.0122079

32. Sword W, Kurtz Landy C, Thabane L, et al. Is mode of delivery associated with postpartum depression at 6 weeks: A prospective cohort study. *BJOG An Int J Obstet Gynaecol.* 2011;118(8):966-977. doi:10.1111/j.1471-0528.2011.02950.x

33. Arbabi M, Taghizadeh Z. Mode of Delivery and Post-partum Depression: A Cohort Study. *J Womens Heal Care.* 2016;05(01):1-5. doi:10.4172/2167-0420.1000303

34. Deng AW, Xiong RB, Jiang TT, Luo YP, Chen WZ. Prevalence and risk factors of postpartum depression in a population-based sample of women in Tangxia Community, Guangzhou. *Asian Pac J Trop Med.* 2014;7(3):244-249. doi:10.1016/S1995-7645(14)60030-4

35. Eckerdal P, Georgakis MK, Kollia N, Wikström A-K, Högberg U, Skalkidou A. Delineating the association between mode of delivery and postpartum depression symptoms: a longitudinal study. *Acta Obstet Gynecol Scand.* 2018;97(3):301-311. doi:10.1111/aogs.13275

36. Mahishale A, Bhatt J. Comparison of level of depression among mothers with lower segment cesarean section and vaginal delivery: A cross-sectional study. *J Sci Soc.* 2017;44(1):15. doi:10.4103/0974-5009.202547

37. Xie RH, Lei J, Wang S, Xie H, Walker M, Wen SW. Cesarean section and postpartum depression in a cohort of chinese women with a high cesarean delivery rate. *J Women's*

- 1  
2  
3 Heal. 2011;20(12):1881-1886. doi:10.1089/jwh.2011.2842  
4  
5  
6 38. Kim Y, Dee V. Sociodemographic and Obstetric Factors Related to Symptoms of  
7  
8 Postpartum Depression in Hispanic Women in Rural California. *JOGNN - J Obstet*  
9  
10 *Gynecol Neonatal Nurs.* 2018;47(1):23-31. doi:10.1016/j.jogn.2017.11.012  
11  
12  
13 39. Malik FR, Malik BB, Irfan M. Comparison of postnatal depression in women following  
14  
15 normal vaginal delivery and caesarean section: A pilot study. *J Postgrad Med Inst.*  
16  
17 2015;29(1):34-37.  
18  
19  
20 40. Nayak M. Prevalence & related factors to postnatal depression: A comparison between  
21  
22 NVD & LSCS mothers. *Int J Res Pharm Sci.* 2020;11(2):2228-2233.  
23  
24 doi:10.26452/ijrps.v11i2.2175  
25  
26  
27 41. Moameri H, Ostadghaderi M, Khatooni E, Doosti-Irani A. Association of postpartum  
28  
29 depression and cesarean section: A systematic review and meta-analysis. *Clin Epidemiol*  
30  
31 *Glob Heal.* 2019;7(3):471-480. doi:10.1016/j.cegh.2019.02.009  
32  
33  
34 42. Xu H, Ding Y, Ma Y, Xin X, Zhang D. Cesarean section and risk of postpartum  
35  
36 depression: A meta-analysis. *J Psychosom Res.* 2017;97:118-126.  
37  
38 doi:10.1016/j.jpsychores.2017.04.016  
39  
40  
41 43. Grivell RM, Dodd JM. Short- and long-term outcomes after cesarean section. *Expert Rev*  
42  
43 *Obstet Gynecol.* 2011;6(2):205-215. doi:10.1586/eog.11.5  
44  
45  
46 44. Gupta M, Saini V. Cesarean section: Mortality and morbidity. *J Clin Diagnostic Res.*  
47  
48 2018;12(9):QE01-QE06. doi:10.7860/JCDR/2018/37034.11994  
49  
50  
51 45. Gupta S, Kishore J, Mala YM, Ramji S, Aggarwal R. Postpartum depression in North  
52  
53 Indian women: Prevalence and risk factors. *J Obstet Gynecol India.* 2013;63(4):223-229.  
54  
55 doi:10.1007/s13224-013-0399-x  
56  
57  
58  
59  
60

46. Savarimuthu RJS, Ezhilarasu P, Charles H, Antonisamy B, Kurian S, Jacob KS. Postpartum depression in the community: A qualitative study from rural south India. *Int J Soc Psychiatry*. 2010;56(1):94-102. doi:10.1177/0020764008097756
47. Hahn-Holbrook J, Cornwell-Hinrichs T, Anaya I. Economic and Health Predictors of National Postpartum Depression Prevalence: A Systematic Review, Meta-analysis, and Meta-Regression of 291 Studies from 56 Countries. *Front Psychiatry*. 2018;8:1-23. doi:10.3389/fpsy.2017.00248
48. Maharashtra D of E and SPDG of. *Economic Survey of Maharashtra 2019-20.*; 2020.
49. Sylvén SM, Papadopoulos FC, Mpazakidis V, Ekselius L, Sundström-Poromaa I, Skalkidou A. Newborn gender as a predictor of postpartum mood disturbances in a sample of Swedish women. *Arch Womens Ment Health*. 2011;14(3):195-201. doi:10.1007/s00737-011-0211-9
50. Gierszewska M, Kaźmierczak M, Araszkiewicz A, Gebuza G, Mieczkowska E, Gierszewska M. Psychosocial determinants of postpartum depression. *Med Biol Sci*. 2014;28(3):25-33. doi:10.12775/mbs.2014.022
51. Levis B, Negeri Z, Sun Y, Benedetti A, Thombs BD. Accuracy of the Edinburgh Postnatal Depression Scale (EPDS) for screening to detect major depression among pregnant and postpartum women: Systematic review and meta-analysis of individual participant data. *BMJ*. 2020;371. doi:10.1136/bmj.m4022
52. Goecke TW, Voigt F, Faschingbauer F, Spangler G, Beckmann MW, Beetz A. The association of prenatal attachment and perinatal factors with pre- and postpartum depression in first-time mothers. *Arch Gynecol Obstet*. 2012;286(2):309-316. doi:10.1007/s00404-012-2286-6

53. Taherifard P, Delpisheh A, Shirali R, Afkhamzadeh A, Veisani Y. Socioeconomic, Psychiatric and Materiality Determinants and Risk of Postpartum Depression in Border City of Ilam, Western Iran. *Depress Res Treat*. 2013;2013. doi:10.1155/2013/653471

**Figure 1** Block and type wise participating hospitals in Pune, India, 2017-18

**Figure 2** Women delivered and followed in Pune, India, 2017-18

**Table 1** Socio-demographic Characteristics of Study Participants (n=3,112), India, 2017-18

Characteristics		Caesarean (n=1556)	Vaginal (n=1556)	Total	Chi Square (p)
		No (%)	No (%)	No (%)	
Age in years	≤ 19	83 (5.38)	117 (7.59)	200 (6.48)	36.99 (<0.001)
	20 – 24	809 (52.40)	907 (58.82)	1716 (55.61)	
	25 – 29	485 (31.41)	415 (26.91)	900 (29.16)	
	30 – 34	133 (8.61)	93 (6.03)	226 (7.32)	
	> 35	34 (2.20)	10 (0.65)	44 (1.43)	
	Data not available	12	14	26	
Parity	1 <sup>st</sup> Para	632 (42.16)	638 (42.85)	1270 (42.50)	0.7 (0.87)
	2 <sup>nd</sup> Para	647 (43.16)	640 (42.98)	1287 (43.07)	
	3 <sup>rd</sup> Para	207 (13.81)	195 (13.10)	402 (13.45)	
	Multipara	13 (0.87)	16 (1.07)	29 (0.97)	
	Data not available	57	67	124	
Annual income in ₹ (1 ₹ =0.013 \$)	Less than 14,999	411 (28.88)	381 (27.27)	792 (28.09)	8.53 (0.01)
	15,000-99,999	933 (65.57)	967 (69.22)	1900 (67.38)	
	100,000+	79 (5.55)	49 (3.51)	128 (4.54)	
	Data not available@	133	159	292	
Education	Graduate/higher	242 (15.76)	153 (10.24)	395 (13.04)	37.74 (<0.001)
	12 <sup>th</sup> /Diploma after 10 <sup>th</sup>	422 (27.47)	356 (23.83)	778 (25.68)	
	High school (8-10 std.)	371 (24.15)	382 (25.57)	753 (24.85)	
	Middle school (5-7 std.)	246 (16.02)	304 (20.35)	550 (18.15)	
	Primary (1-4 std.)	154 (10.03)	159 (10.64)	313 (10.33)	
	Illiterate	101 (6.58)	140 (9.37)	241 (7.95)	

Occupation	Data not available	20	62	82	3.63 (0.72)
	Profession	29 (1.88)	17 (1.13)	46 (1.51)	
	Semi-profession	12 (0.78)	14 (0.93)	26 (0.85)	
	Clerk, shop-owner, farmer	38 (2.47)	38 (2.52)	76 (2.50)	
	Skilled worker	33 (2.14)	32 (2.13)	65 (2.13)	
	Semi-skilled worker	20 (1.30)	24 (1.59)	44 (1.44)	
	Unskilled worker	32 (2.08)	29 (1.93)	61 (2.00)	
	Unemployed	1377 (89.36)	1351 (89.77)	2728 (89.56)	
	Data not available	15	51	65	

std.=Standard; @ Includes not having ration card, hence no information about income

**Table 2** Comparison of postpartum depression with the mode of delivery, India, 2017-18

EPDS score	Caesarean (n=1424)	Vaginal (n=1407)	Emergency	Elective
0	55.20	57.71	57.51	49.35
1	6.46	7.46	6.37	7.52
2	9.55	10.73	8.75	11.76
3	7.09	7.11	6.65	8.82
4	7.23	5.47	6.65	9.80
5	3.72	3.91	3.42	4.58
6	<b>2.67</b>	<b>1.71</b>	<b>2.76</b>	<b>2.61</b>
7	<b>1.83</b>	<b>1.78</b>	<b>1.90</b>	<b>0.98</b>
8	<b>1.47</b>	<b>1.00</b>	<b>1.43</b>	<b>1.31</b>
9	<b>0.98</b>	<b>0.78</b>	<b>1.24</b>	<b>0.00</b>
≥10	<b>3.79</b>	<b>2.35</b>	<b>3.33</b>	<b>3.27</b>
Overall	Chi square=15.77 p=0.11		Chi square=16.23 p=0.09	
0-5 and >6	Chi square=7.99 p=0.005		Chi square=1.34 p=0.25	

EPDS= Edinburgh Postnatal Depression Scale

**Table 3** Multivariable binary logistic regression analysis of risk factors for post-partum depression, India, 2017-18

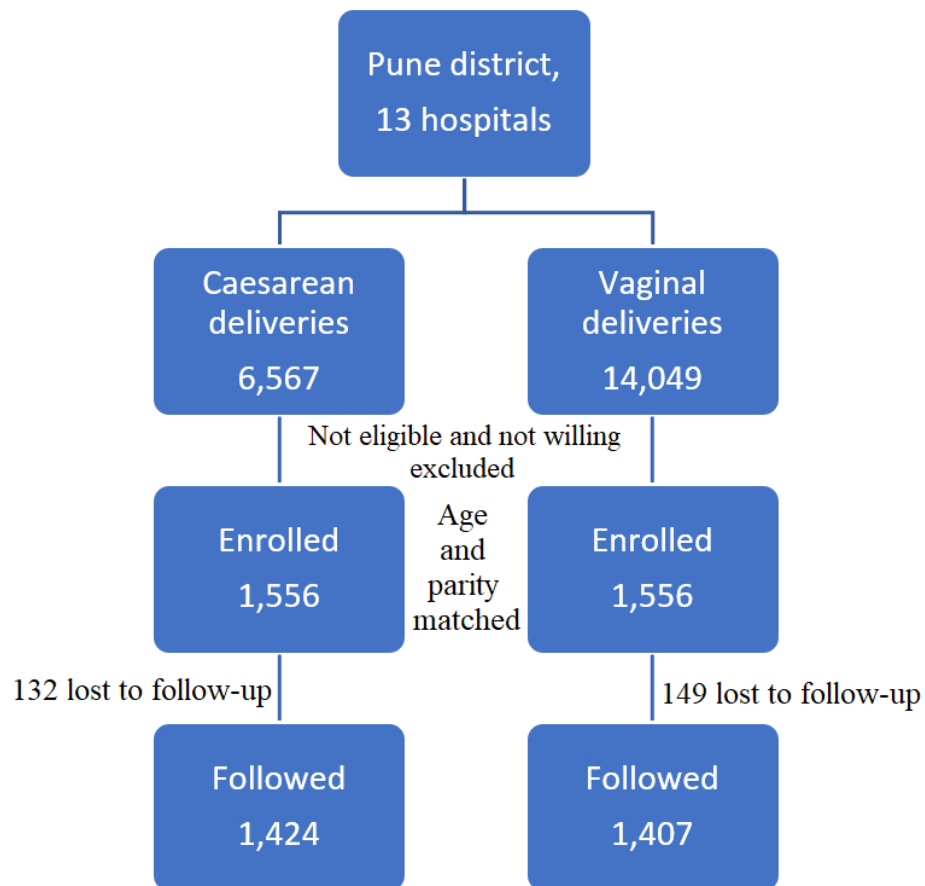
		EPDS Score		Total	Adj. Odds Ratio (95% CI)
		≥10	<10		
Age in years	<25	62	1673	1735	2.00 (1.16-3.43)
	≥25	25	1048	1073	1
Income	Non-BPL	62	1777	1839	1.51 (0.86-2.63)
	BPL	19	704	723	1
Education	≤ 10 <sup>th</sup> std.	31	1046	1077	0.78 (0.48-1.28)
	> 10 <sup>th</sup> std.	54	1628	1682	1
Occupation	Employed	8	281	289	1.07 (0.48-2.37)
	Unemployed	77	2412	2489	1
Parity	>2	12	385	397	1.10 (0.57-2.15)
	≤2	72	2251	2323	1
Mode of Delivery	Caesarean	54	1370	1424	1.88 (1.16-3.06)
	Vaginal	33	1374	1407	1

BPL=Below poverty line





**Figure 1** Block and type wise participating hospitals in Pune, India, 2017-18



**Figure 2** Women delivered and followed in Pune, India, 2017-18

369x397mm (57 x 57 DPI)

STROBE (Strengthening The Reporting of OBservational Studies in Epidemiology) Checklist

A checklist of items that should be included in reports of observational studies. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

Section and Item	Item No.	Recommendation	Reported on Page No.
Title and Abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	
Introduction			
Background/Rationale	2	Explain the scientific background and rationale for the investigation being reported	
Objectives	3	State specific objectives, including any prespecified hypotheses	
Methods			
Study Design	4	Present key elements of study design early in the paper	
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	
Participants	6	(a) Cohort study—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up  Case-control study—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls  Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants	
		(b) Cohort study—For matched studies, give matching criteria and number of exposed and unexposed  Case-control study—For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	

Section and Item	Item No.	Recommendation	Reported on Page No.
Data Sources/ Measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	
Bias	9	Describe any efforts to address potential sources of bias	
Study Size	10	Explain how the study size was arrived at	
Quantitative Variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical Methods	12	(a) Describe all statistical methods, including those used to control for confounding	
		(b) Describe any methods used to examine subgroups and interactions	
		(c) Explain how missing data were addressed	
		(d) Cohort study—If applicable, explain how loss to follow-up was addressed  Case-control study—If applicable, explain how matching of cases and controls was addressed  Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive Data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Cohort study—Summarise follow-up time (eg, average and total amount)	
Outcome Data	15*	Cohort study—Report numbers of outcome events or summary measures over time	
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	
		Cross-sectional study—Report numbers of outcome events or summary measures	

Section and Item	Item No.	Recommendation	Reported on Page No.
Main Results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	
		(b) Report category boundaries when continuous variables were categorized	
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other Analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key Results	18	Summarise key results with reference to study objectives	
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	
Generalisability	21	Discuss the generalisability (external validity) of the study results	
Other Information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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# BMJ Open

## Assessment of difference of postpartum depression among caesarean and vaginally delivered women at six-week follow-up in the hospitals in Pune District, India: An observational cohort study

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<b>Primary Subject Heading</b>:	Mental health
Secondary Subject Heading:	Reproductive medicine, Mental health
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**Assessment of difference of postpartum depression among caesarean and vaginally delivered women at six-week follow-up in the hospitals in Pune District, India: An observational cohort study**

Dr. Prakash Prabhakar Rao Doke,<sup>1</sup>

Dr. Varsha Mahesh Vaidya,<sup>1</sup>

Dr. Arvinder Pal Singh Narula,<sup>1\*</sup>

Dr. Manjiri Chaitanya Datar,

Dr. Archana Vasant Rao Patil,<sup>2</sup>

Dr. Tushar Madhav Panchanadikar,<sup>1</sup>

Dr. Girija Narendra Wagh,<sup>1</sup>

<sup>1</sup>Bharati Vidyapeeth Deemed University Medical College, Pune, India

<sup>2</sup> Directorate of Health Services, Government of Maharashtra, Pune, India

\* Corresponding author

Dr. Arvinder Pal Singh Narula,

Address: Department of Community Medicine, Bharati Vidyapeeth Deemed University Medical College, Satara Road, Dhanakawadi, Pune, India, 411043

Email: arvindernarula@rediffmail.com

Telephone: +918805984393

Fax: +9102024372175

**Keywords:** Postpartum Depression; Prevalence; Caesarean delivery; Socio-demographic characteristics; Gender

**Word count:** 3,813 (excluding title page, abstract, references, acknowledgements, and mandatory statement, figures and tables)



**Assessment of difference of postpartum depression among caesarean and vaginally delivered women at six-week follow-up in the hospitals in Pune District, India: An observational cohort study**

**ABSTRACT**

**Objectives** To compare the proportion of postpartum depression at six weeks among caesarean delivered and vaginally delivered women and to assess its association with some socio-demographic factors.

**Design** It was a descriptive comparative study with prospective enrolment. We followed the enrolled women and assessed them for postpartum depression (PPD) six weeks after delivery.

**Setting** We conducted the study in Pune district, India from July 2017 to December 2018. The study sites were all non-teaching government hospitals performing five or more caesarean sections per month and two teaching hospitals one government, and one private.

**Participants** We included participant women who have undergone caesarean section in the participating hospitals and residents of Pune district in the study group. The women delivered vaginally and matching in age and parity were included in the comparison group. We followed 1,556 women in each group.

**Main outcome measures** Edinburgh Postnatal Depression Scale (EPDS) score 10 or more for each woman was the primary outcome. Chi-square test and multivariable binary logistic regression were performed to assess the effect of delivery mode on postpartum depression.

**Results** The proportion of postpartum depression was 3.79% among caesarean delivered women and 2.35% among vaginally delivered women at six weeks (Chi square=4.50; p=0.03). The adjusted odds ratio was 1.86 (95% CI=1.14 to 3.03). Age less than 25 years had higher risk of

postpartum depression. The adjusted odds ratio was 2.10 (95% CI =1.21-3.65). The study did not observe any association between postpartum depression and income, education, occupation or sex of the new-born child.

**Conclusions** We conclude that young women particularly caesarean delivered should be screened six weeks after delivery.

**Keywords:** Postpartum Depression; Prevalence; Caesarean delivery; Socio-demographic characteristics; Gender

### **Strengths and limitations of this study**

- ▶ The present study is a large multi-site study.
- ▶ Trained health care workers assessed the women six weeks postpartum.
- ▶ The authors didn't assess or ask history of postpartum depression during pregnancy or immediately after delivery.
- ▶ We did not include a non-teaching private hospital.

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**Assessment of difference of postpartum depression among caesarean and vaginally delivered women at six-week follow-up in the hospitals in Pune District, India: An observational cohort study**

**INTRODUCTION**

**Background**

Women face major depression 1.6 to 2.6 times more than men.<sup>1</sup> This difference is most apparent in the postpartum period. The American Psychiatric Association’s Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5), defines postpartum depression specifying the period as; ‘most recent episode of major depression if onset of mood symptoms occurs during pregnancy or in the four weeks following delivery’.<sup>2</sup> To assess the postpartum depression (PPD), Edinburgh Postnatal Depression Scale (EPDS) is the most commonly used tool. The prevalence is influenced by the tool used and time of assessment after birth. Most psychiatrists and obstetricians consider the period up to one year,<sup>3–10</sup> but the symptoms may persist longer.<sup>11</sup> Various secondary data analyses have estimated that globally about 10-15% women suffer from PPD.<sup>12–14</sup> This common complication of childbearing is a disabling but treatable mental disorder. The consequences of PPD are related to the mother, the child, and mother-child interactions. The first category includes a woman’s social relationship including with her husband. Severe malnutrition, health problems like diarrhea, language and cognitive development among the children, represent the second category. Mother-to-child bonding, breastfeeding problems represent the third category.<sup>1,15,16</sup> Studies identifying its risk factors are fewer than studies

estimating incidence/prevalence.<sup>3,4,17,18</sup> The risk factors are classified as socio-economical and biological. The risk factors may be present during pregnancy or appear after childbirth.<sup>1,11</sup>

Although mode of delivery is one of the recognized risk factors, the psychiatric risk factors receive more attention. Some studies have shown a higher risk of postpartum depression after cesarean section,<sup>19,20</sup> but some studies did not.<sup>21,22</sup> Most of these studies are small and from a single institution. On the other hand, some large studies did not include the mode of delivery as a risk factor.<sup>17,23</sup> The woman undergoing cesarean section has mental stress due to exposure to operation and expenditure incurred. Additionally, the feeling of guilt exists, as the women consider caesarean mode of delivery as a failure on the part of the mother to endure pain. Such a guilt also contributes to development of PPD. Hence postpartum depression is more likely to occur among cesarean delivered women than vaginally delivered. We perceived the need for a comparative study because globally the proportion of cesarean is increasing and absence of large studies particularly from India. Additionally, the authors considered the sex of the new-born as one variable because some Indian studies have observed that the birth of a girl child is also a risk for PPD.<sup>20,24,25</sup> In India, despite the launch of the National Mental Health Programme in 1982, maternal mental is not given due attention.

## Objectives

1. To compare the proportion of PPD at six weeks between cesarean delivered and vaginally delivered women, in Pune District
2. To assess its association with socio-economic factors including the sex of the new-born.

## MATERIAL AND METHODS

### Study Design

It was an observational and descriptive study comparing PPD six weeks after delivery among women who have undergone caesarean and vaginal delivery.

**Settings**

Pune District is the second populous district in Maharashtra State, and fourth in India, having a population of 9,429,408, as per the last census 2011. Pune Municipal Corporation together with Pimpri Chinchwad Municipal Corporation constitutes 51.46% of the district population. The female to male (per 1,000) ratio is 915 and the female literacy rate is 81.05%. We included all nine non-teaching government hospitals conducting at least five cesareans per month, one government teaching hospital, and one private teaching hospital (the nodal site). The authors conducted this study in collaboration with the Directorate of Health Services Government of Maharashtra. The selected hospitals included five tertiary care hospitals (two medical college hospitals, one district hospital, two municipal corporation hospitals), six sub-district hospitals (includes one women's hospital), and two community health centres from different places. Figure 1 gives the details.

**Period**

The study duration was from 1<sup>st</sup> July 2017 to 31<sup>st</sup> December 2018 including the enrolment period from 1<sup>st</sup> September 2017 to 31<sup>st</sup> March 2018.

**Participants**

A woman who was a resident of the Pune district and ready to come for follow-up was eligible for inclusion. We excluded a woman who does not know even one language out of English, Marathi, or Hindi; or has a critical illness needing immediate transfer to a higher institution (non-study site); or has a severe psychiatric illness (unable to understand and respond). All women who had undergone caesarean section during the enrolment period were included as ‘study

participants' within 48 hours after caesarean section. After enrolling a woman in the study group, we included the first vaginally delivered woman matching age ( $\pm 2.5$  years) and parity in the comparison group. Figure 2 depicts the flowchart of enrolment of participants.

### Follow-up

The research team requested all women for follow-up at six weeks (coincident with the initiation of immunization of the child) at the hospitals. The research team frequently reminded the women on the phone about their due visit. We invited the women not attending the hospital for specially organized follow-up camps. Health care workers visited the houses of the women who did not participate in the institution or camp and requested them to come for follow-up. A social worker conducted a telephonic interview of the women who neither visited the institution nor follow-up camp. The follow-up was started on 16<sup>th</sup> October 2017 and stopped on 30<sup>th</sup> June 2018. We advised all women suspected of having postpartum depression to consult a psychiatrist

### Data collection

The authors notified a pair consisting of an obstetrician and the in-charge nurse as the 'site coordinator team' from each participant hospital. But, in the medical college hospitals, we formed unit-wise teams. The Department of Community Medicine and Psychiatry trained them and the research team (one coordinator who was a public health specialist and two medico-social workers). That one-day training included an introduction to the study, collection of initial information, follow-up and monitoring, and filling the EPDS format. Trainees practiced filling of EPDS format interviewing colleague as a delivered woman. Women were enrolled before discharge (48 hours to seven days after delivery). A site coordinator team member filled the initial part of the format by collecting information from records and remaining part by face-to-face interviews. They again interviewed the women during follow-up visits, and responses were

recorded on the printed EPDS format. A psychiatrist assessed the women visiting the nodal site (delivered in that institution and some women from nearby areas). The research coordinator and the two medico-social workers supervised and coordinated follow-up and data collection.

Authors, along with the research coordinator, regularly visited all the sites. We collected the filled-up forms from the rural areas monthly or during visits, and weekly from corporation areas. The research coordinator scrutinized the forms and contacted the women on the phone if needed.

**Variables**

The site coordinator collected the information about the mode of delivery (including emergency or elective caesarean), age, parity, education, family income, and occupation. We decided the socioeconomic class based on Kuppuswamy's classification, which uses the occupation and education of the head of the family and the family's monthly income.<sup>26</sup> We used colour of the ration card as a proxy of income. The government has provided yellow, orange, and white colour ration cards to families having annual income less than ₹.15,000, ₹.15,000 to .99,999, and ₹.100,000 or above respectively (1 ₹ =0.013 \$). Yellow ration card holders are considered as Below Poverty Line (BPL) and are eligible for benefits under some schemes.

We calculated the depression score for each woman using EPDS that Cox JL developed in 1987.<sup>27</sup> It is a '10 item' scale assessing various aspects of depression on a week recall of mood and feelings. The interviewing persons ensured a response for each item. Each item is scored on a severity scale ranging from 0 to 3, thus the possible highest total score is 30.

**Data sources/measurement**

The source of data was the case report form. The interview schedule comprised of information about the socioeconomic characteristics of the participants and detailed obstetric history. The site coordinator assessed the woman during the follow-up visit at six weeks for PPD using EPDS,

which was validated and translated into Marathi (local language). The data entry operator entered the information on the Excel Sheet. Then the total score of each woman was calculated. We considered the most commonly used cut-off score of  $\geq 10$  of a woman to identify as having postpartum depression.

### **Bias**

The translated EPDS format was not having any identification marker about the mode of delivery and thus the assessors were blinded to the mode of delivery.

### **Study Size**

To capture a PPD difference of 7.6% between caesarean section and vaginal delivery,<sup>10</sup> with a 95% confidence and 80% power, the sample size required was 228 in each group. However, this study was a part of a larger study in which we compared puerperal infection. Based on available rates of puerperal infection, 1,556 participants in each group were enrolled and followed.

### **Statistical methods**

Descriptive statistics as percentages for the categorical variables were tabulated for selected predictors. We analysed the data using, 'Statistical Package for the Social Science' (SPSS) Version 25.0. Chi-square test with Yates's correction was applied to assess the association between PPD and socio-demographic and obstetric parameters of the participants. The authors calculated the adjusted odds ratio using multivariable binary logistic regression. Division of age in two groups was based on observations, income on entitlement for government schemes (BPL), education on years of schooling, and occupation on employed or not. P-value  $<0.05$  was considered to be statistically significant.

### **Patient and Public Involvement**



Participant women were not involved in developing the study design but they were given all information about the study and referred whenever necessary. Officers from health department were involved in evolving study design.

**RESULTS**

During the enrolment period in the selected 13 hospitals, 6,567 cesareans and 14,049 vaginal deliveries were conducted. About 40% of cesarean delivered women were not eligible due to residence outside Pune District and 40% were unwilling to come for follow-up. Around 15% were excluded due to the language barrier and about 5% were critically ill or having a psychiatric problem.

The number of mothers contacted directly during a hospital visit, through camps and phone calls was roughly 50%, 30%, and 20% respectively.

We followed 2,831 women (90.97%) at six weeks. The details about delivered, enrolled, and followed women are given in figure 2. Illegible handwriting plus the inability to confirm the contents on the phone and unfilled sections were the common reasons for incomplete data. Some women were not available on the phone and some migrated to other districts.

**Socio-demographic characteristics**

Out of 3,112 participants, the data from the varied number of women could not be obtained for certain variables. About 68% of participants were from Municipal Corporation areas. Table 1 gives only the socio-demographic characteristics of the participants by mode of delivery.

The mean age of participants was 23.96 ( $\pm 3.72$ ) years. The younger age group up to 25 years was the dividing line. The proportions of women in younger age groups were lesser among caesarean delivered than vaginally delivered. The overall proportion of the first para plus 2nd para was 85.57%, and there was no difference between the two groups. The proportion of

passing 10<sup>th</sup> standard among caesarean was 43.22%, while it was 34.07% among vaginally delivered.

### **Postpartum Depression at six weeks**

We could not interview 8.48% and 9.58% of participants from the caesarean and comparison group, respectively. The proportion of postpartum depression having an EPDS score of 10 or more was 3.79% among caesarean and 2.35% among vaginally delivered women (Chi-square=4.50; p=0.03). Chi-square test was applied to the overall (disregarding mode of delivery) distribution of the variables given in table 1 and EPDS score less than ten and >10, showed no association between socio-demographic characteristics and EPDS. The details about the mode of delivery and EPDS score group are given in table 2, which shows that the proportion of caesarean delivered women who scored six and above was consistently higher than that of vaginally delivered women. This consistency was not observed in the type of caesarean section. Hence, we separately applied two by two chi-square test with Yate's correction making two groups as given in table 2. There was no significant difference between the proportion of women having EPDS score >10 among women undergone emergency and elective caesarean. The sex of the new-born child had no association with PPD (Chi-square=0.04; p=0.87)

The adjusted odds ratios of various factors for EPDS score ten or more calculated using multivariable binary logistic regression are given in table 3. We observed a significantly high odds ratio (1.86; 95% CI=1.14-3.03), indicating almost double the risk of PPD among caesarean delivered women. Similarly, the young mothers less than 25 years also had a significantly high odds ratio (2.10; CI=1.21-3.65), indicating more than double the risk of PPD than elder mothers. The rest of the factors did not have any association with EPDS score.

### **DISCUSSION**

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The authors observed a prevalence of PPD less than four in Pune district. The study observed that odds of having PPD are higher among caesarean delivered women than vaginally delivered women. Women aged less than 25 years also have higher odds of having PPD.

About effect of mode of delivery, even WHO is not consistent. The mode of delivery initially was not included in the risk factor list, <sup>11</sup> later indicated that caesarean delivery is associated with a higher risk for PPD.<sup>1</sup> Some studies, including a review study, did not consider the effect of the mode of delivery.<sup>17,28</sup> With the increasing number of caesarean sections, ascertaining its effect on PPD is necessary. But there is no concordance between the results of various studies. Some studies did not show an association between the mode of delivery and PPD.<sup>21,22,29–32</sup> In some studies, an association was observed but not significant or disappeared after adjusting for confounders.<sup>5,18,20,33–35</sup> One reason for the non-significant difference is the inadequacy of sample size. Many studies showed a significantly higher increased risk due to caesarean section.<sup>36–38</sup> All four comparative studies involving 50 to 100 participants in each group observed a higher risk of PPD among caesarean delivered women.<sup>19,36,39,40</sup> Two meta-analyses clearly showed increased risk due to caesarean section.<sup>41,42</sup> But most of the studies were small and from a single institution. Only two studies reported a higher risk with vaginal delivery.<sup>5,10</sup> The reasons for higher PPD among vaginally may be related to a woman's pain during and after episiotomy, repair of tear or forceps application, etc.<sup>29</sup> The higher risk of PPD due to caesarean section can be consequent to postpartum complications, including infection, haemorrhage, intra-operative complications, blood transfusion, more extended hospital stay, and higher expenditure.<sup>43,44</sup> Secondly, women undergoing non-vaginal delivery can have more probability of self-reported symptoms.

Contrary to the present study, the range of PPD observed in India has a higher range from 7.5 to 31.4%.<sup>3,4,10,14,15,19,21,22,24,25,30,31,36,40,45,46</sup> A meta-analysis of Indian studies observed a range of 3 to 47%; concluded that the average proportion of PPD was 19%.<sup>14</sup> The meta-analysis and the references quoted in the present study pointed out the higher prevalence in South India. The same meta-analysis, an upward trend, but the authors did not observe any trend in the occurrence of PPD while analysing the referred studies in this article. The difference can be due to two reasons; firstly, we have referred to fewer articles, and secondly, they are relatively recent. The meta-analysis also observed that the prevalence was higher in urban areas than rural areas, and a higher proportion was reported from studies in hospital settings than in community settings.<sup>14</sup> Our estimated prevalence of PPD is on the lower side. The economic and health indicators affect the PPD.<sup>47</sup> Pune District has better health and economic indicators.<sup>48</sup> The assessors were not psychiatrists or psychologists; some responses were through phone calls. But both these practices are documented.

The proportion of PPD reported during the last two decades in various countries was from 5.3% in Turkey to 42.6% in California, USA.<sup>7,10,20,22,29,32,35,38,49</sup> WHO had quoted studies wherein the PPD ranged from 10% in Uganda to 40% in Pakistan.<sup>1</sup> In another report reviewing maternal mental health, specifically in low and middle-income countries, the prevalence ranged from 10.7% in Nigeria to 50% in Guyana.<sup>11</sup> In a global review, minimum PPD (4%) from Japan and high PPD (63.9%) in America were noted.<sup>12</sup> A review from Asian countries pointed out that Malaysia had the lowest PPD (3.5%) and Pakistan had the highest (63.3%).<sup>13</sup> The lower prevalence in our study is not an outlier.

For better supervision and thereby assurance of quality, we limited the number of participating hospitals by applying the selection criterion. The history of PPD during pregnancy

and psycho-social familial relations was also not asked. But we assume whatever a small proportion of women have such a history, the proportion ought to be similar in both the groups. Although the American Psychiatric Association included symptoms occurring within four weeks of delivery under postpartum depression, the study considered the conventional obstetric postpartum period of six weeks. In India, postnatal visits are less frequent than ante-natal visits. During the postnatal visit, an assessment for PPD is not carried out. Due to socio-cultural traditions, women usually do not move out of the home for about six weeks. The women visit the institutions to initiate vaccination for their children and, hence, we planned assessment at that time. Therefore, the number of lost follow-ups was less than 10%. Although our study was primarily confined to the government hospitals, any private hospital providing immunization services can start assessing the women.

Apart from socio-cultural and biological factors, the tool of assessment is also an important determinant. The most used tool is EPDS which is in vogue since the 1980s.<sup>12</sup> There ought to be inconsistency when different tools are used. The accepted cut-off point also determines it. One report had quoted studies demonstrating the effects of the assessment system, changing cut-off points, and time of assessment.<sup>11</sup> Various investigators have used EPDS cut-off points from 7 to 13. The present study used the EPDS tool to assess PPD, and considered the cut-off point as ten and above. Many studies considered a higher score of 12 or 13 as a cut-off point.<sup>6,7,8,18,20,25,30–32,37,49,50</sup> But several studies have considered a cut-off of 10 points like the present study.<sup>3,4,10,15,28,36,38,39</sup> Moreover, two large studies after assessing sensitivity and specificity have concluded that score 10 is best cut-off for screening.<sup>51,52</sup> Even American Academy of Pediatrics recommended cut off 10.<sup>53</sup> Hence we decided to consider cut-off score 10. Lower cut-off points of nine,<sup>11,54</sup> or seven are also used.<sup>34</sup> EPDS is not a diagnostic tool, but it is a screening tool. An

EPDS score of six and above had already been used in one country and had 100% sensitivity and is quoted in a document by WHO.<sup>11</sup> Lower the cut-off point higher is the sensitivity, but specificity reduces. But screening tests are meant to capture maximum suspected patients for further evaluation.

The time of the evaluation is an important factor. The studies have been conducted as early as within three days 40 to one year.<sup>6,8,15,38</sup> An inexperienced person may classify maternal blues as PPD, which has a similar presentation and appears within few days of delivery. It is observed that the prevalence of PPD decreases with time.<sup>49</sup> The meta-analysis study in India observed that a pooled prevalence of 22% was reduced to 19% after deducting studies assessing PPD within two weeks.<sup>14</sup>

The association of PPD with age is inconsistent; some did not show any association PPD,<sup>4,10,18,54</sup> but some did.<sup>3,46</sup> Few studies have reported that increasing age heightens the chances of getting PPD, particularly after 30 years.<sup>6,25,30</sup> The pooled prevalence of PPD was estimated as 20% and 21% when studies with mean maternal age of  $\leq 25$  years and  $> 25$  years, but the difference was not significant.<sup>14</sup> But chances are very high among women less than 20 years.<sup>46</sup> The present study confirms that women less than 25 years have almost double risk. The higher risk may be bi-polar; young<sup>46</sup> and middle-aged are at increased risk.<sup>6,25,30</sup> Lower prevalence among elder mothers can reflect better psycho-social adjustment within the family by 25 years of age. The present study did not find any association between income and PPD. The association between PPD and income is inconsistent.<sup>18,55</sup> We did not observe any association consonant with one study<sup>4</sup> but some studies observed association.<sup>15,30</sup> In Indian society, if the woman has one or more girls, the birth of a male child is preferred. The woman is blamed or made to feel guilty for giving birth to a female child. Many studies reported a higher prevalence

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of PPD after the birth of a female child.<sup>20,25,34</sup> Like the present study few studies did not observe such association.<sup>8,49</sup> The problem is state or district-specific. Additionally, in the last two decades, extensive efforts have been taken by the government and non-governmental agencies to create awareness about gender bias.

The comparison between elective and emergency caesarean is full of variations. There was no difference between an emergency and elective caesarean section<sup>18</sup>. Some studies reported higher risk with elective caesareans,<sup>20,37</sup> while one study reported contradictory findings.<sup>42</sup> A higher risk of PPD after an emergency caesarean section is a reflection of acute stress reactions.<sup>1</sup>

Even this low prevalence observed in the present study amounts to about 50,000 cases per year in the state. If PPD is untreated, the new-born and the whole family may face some consequences. Maximum women may be screened by applying sensitive criteria by paramedical persons before referral to a psychiatrist, as there is a shortage of psychiatrists. We suggest further research involving assessment trained paramedical, in the rural areas, at that most feasible period is six weeks and with a robust referral system to alleviate the common problem of delivered women.

We did not include private hospitals and the time of onset of the symptoms. The assessment was done only at six weeks. History of psychological problems and family violence etc., was not asked. A psychiatrist did not assess all the women. Complete blinding was not possible as many interviewers knew the women. Some interviews were telephonic. The authors did not separately analyse data by mode of collection or person collecting. The overall prevalence may not apply to the general population because the proportion of caesarean is less than 50%.

The present study is a multisite study involving a large number of participants. It is the second largest one among all the referred studies from the last two decades.<sup>35</sup> It is the largest Indian study covering a large district. Trained health care workers assessed the women. Lost to follow-up women are less than 10%.

## Conclusions

The study confirmed younger age and caesarean are risk factors. In all hospitals at six weeks postpartum, universal assessment of delivered women, particularly young and caesarean delivered, screening using EPDS score should be initiated through nurses or medico-social workers. The sensitivity and specificity studies using six or more EPDS scores need consideration.

**Contributors** PPD was involved in planning, data analysis and writing manuscript. VMV and APSN were involved in planning and supervision. MCD was involved in training and assessment. AVP was involved in monitoring follow up. TMP was involved in supervision, monitoring and collection of data. GNW was involved in supervision and collection of data. All the authors contributed to writing manuscript and approved the manuscript.

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**Competing interests** All authors declare that competing interests are nil.

**Consent for participation and publication** The authors obtained consent for participation and publication from all the participants.



**Ethics approval** The study was approved by the Institutional Ethics Committee (DCGI Regd. No. ECR/313/Inst/MH/2013/RR-16) vide letter number IEC/2017/34 Date: 31Aug 2017. The authors obtained written informed consent from all the women for participation and subsequent publication.

**Data sharing statement** All the data will be shared on reasonable request to corresponding author.

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**REFERENCES**

1. WHO and UNFPA. *Mental Health Aspects of Women’s Reproductive Health.*; 2009.
2. American Psychiatric Association. *Diagnostic and Statistical Manual Fo Mental Disorder DSM-5.* Fifth. American Psychiatric Publishing; 2013.
3. Agarwala A, Arathi Rao P, Narayanan P. Prevalence and predictors of postpartum depression among mothers in the rural areas of Udupi Taluk, Karnataka, India: A cross-sectional study. *Clin Epidemiol Glob Heal.* 2019;7(3):342-345. doi:10.1016/j.cegh.2018.08.009
4. Gaikwad S, Mundada V, Dhande V, Doibale M. Assessment of postnatal depression and some associated risk factors among mothers attending the immunisation outpatient

- department in a tertiary health care centre : a cross sectional study. *Int J Community Med Public Heal*. 2019;6(10):4412-4416.
5. Chaaya M, Campbell OMR, El Kak F, Shaar D, Harb H, Kaddour A. Postpartum depression: Prevalence and determinants in Lebanon. *Arch Womens Ment Health*. 2002;5(2):65-72. doi:10.1007/s00737-002-0140-8
  6. Inandi T, Elci OC, Ozturk A, Egri M, Polat A, Sahin TK. Risk factors for depression in postnatal first year, in eastern Turkey. *Int J Epidemiol*. 2002;31(6):1201-1207. doi:10.1093/ije/31.6.1201
  7. Kaya L, Cigdem Z. The relationship between mode of delivery and postpartum derpression. *J Heal Educ Promot*. 2019;8(5):1-6. doi:10.4103/jehp.jehp
  8. Lagerberg D, Magnusson M. Infant gender and postpartum sadness in the light of region of birth and some other factors: A contribution to the knowledge of postpartum depression. *Arch Womens Ment Health*. 2012;15(2):121-130. doi:10.1007/s00737-012-0265-3
  9. Regmi S, Sligl W, Carter D, Grut W, Seear M. A controlled study of postpartum depression among Nepalese women: Validation of the Edinburgh Postpartum Depression Scale in Kathmandu. *Trop Med Int Heal*. 2002;7(4):378-382. doi:10.1046/j.1365-3156.2002.00866.x
  10. Shriraam V, Shah PB, Anitha RM, BWC S. A community-based study of postpartum depression in rural South India. *Indian J Soc Psychiatry*. 2019;35:64-68. doi:10.4103/ijsp.ijsp\_13\_18
  11. WHO and UNFPA. *Maternal Mental Health and Child Health and Development in Low and Middle Income Countries*.; 2008. Accessed June 23, 2020. [https://www.who.int/mental\\_health/prevention/suicide/mmh\\_jan08\\_meeting\\_report.pdf?u](https://www.who.int/mental_health/prevention/suicide/mmh_jan08_meeting_report.pdf?u)

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12. Roshaidai Mohd Arifin S, Cheyne H, Maxwell M. Review of the prevalence of postnatal depression across cultures. *AIMS Public Heal*. 2018;5(3):260-295. doi:10.3934/publichealth.2018.3.260

13. Klainin P, Gordon D. International Journal of Nursing Studies Postpartum depression in Asian cultures : A literature review. *Int J Nurs Stud*. 2009;46:1355-1373. doi:10.1016/j.ijnurstu.2009.02.012

14. Upadhyay R, Chowdhury R, Salehi A, et al. Postpartum depression in india: A systematic review and meta-analysis. *Bull World Health Organ*. 2017;95(10):706-717.

15. Amipara T, Baria H, Nayak S. A study on postpartum depression and its association with infant feeding practices and infant nutritional status among mothers attending the anganwadi centers of Valsad district, Gujarat, India. *Indian J Community Med*. 2020;45(3):299. doi:10.4103/ijcm.IJCM\_171\_19

16. Slomian J, Honvo G, Emonts P, Reginster JY, Bruyère O. Consequences of maternal postpartum depression: A systematic review of maternal and infant outcomes. *Women's Heal*. 2019;15. doi:10.1177/1745506519844044

17. Beck CT. Predictors of Postpartum Depression. *Nurs Res*. 2001;50(5):275-285. doi:10.1089/jwh.2014.4824

18. Goker A, Yanikkerem E, Demet MM, Dikayak S, Yildirim Y, Koyuncu FM. Postpartum Depression: Is Mode of Delivery a Risk Factor? *ISRN Obstet Gynecol*. 2012;2012:1-6. doi:10.5402/2012/616759

19. Dinesh P, Raghavan S. A comparative study of prevalence of postnatal depression among subjects with normal and cesarean deliveries. *IAIM*. 2018;5(2):6-11.

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20. Johnstone SJ, Boyce PM, Hickey AR, Morris-Yates AD, Harris MG. Obstetric risk factors for postnatal depression in urban and rural community samples. *Aust N Z J Psychiatry*. 2001;35(1):69-74. doi:10.1046/j.1440-1614.2001.00862.x
21. Patel V, Rodrigues M, Nandita DeSouza M. Gender, Poverty, and Postnatal Depression: A Study of Mothers in Goa, India. *Am J Psychiatry*. 2002;159:1.
22. Sheela CN, Venkatesh S. Screening for Postnatal Depression in a Tertiary Care Hospital. *J Obstet Gynecol India*. 2016;66(1):72-76. doi:10.1007/s13224-015-0766-x
23. Faisal-Cury A, Menezes PR. Type of delivery is not associated with maternal depression. *Arch Womens Ment Health*. 2019;22(5):631-635. doi:10.1007/s00737-018-0923-1
24. Jain A, Tyagi P, Kaur P, Puliyel J, Sreenivas V. Association of birth of girls with postnatal depression and exclusive breastfeeding: An observational study. *BMJ Open*. 2014;4(6). doi:10.1136/bmjopen-2013-003545
25. Modi VP, Parikh MN, Kartik VS. A Study on Prevalence of Postpartum Depression with Risk Factors. *Ann Indian Psychiatry*. 2018;2(June):27-32. doi:10.4103/aip.aip
26. Wani R. Socioeconomic status scales-modified Kuppuswamy and Udai Pareekh's scale updated for 2019. *J Fam Med Prim Care*. 2019;8(6):1846. doi:10.4103/jfmpe.jfmpe\_288\_19
27. Cox JL, Holden JM, Sagovsky R. Detection of Postnatal Depression: Development of the 10-item Edinburgh Postnatal Depression scale. *Br J Psychiatry*. 1987;150(JUNE):782-786. doi:10.1192/bjp.150.6.782
28. Park JH, Karmaus W, Zhang H. Prevalence of and risk factors for depressive symptoms in Korean women throughout pregnancy and in postpartum period. *Asian Nurs Res (Korean Soc Nurs Sci)*. 2015;9(3):219-225. doi:10.1016/j.anr.2015.03.004

29. Eisenach J c, Pan PH, Smiley R, Lavandhomme P, Landau R, Houle TT. Severity of Acute Pain After Childbirth, but not Type of Delivery, Predicts Persistent Pain and Postpartum Derpession. *Pain*. 2008;140(1):78-94. doi:10.1038/jid.2014.371

30. Saldanha D, Rathi N, Bal H, Chaudhari B. Incidence and evaluation of factors contributing towards postpartum depression. *Med Jpurnal Dr DY Patil Univ*. 2014;7(1102):309-316. doi:10.4103/0975-2870.128972

31. Shivalli S, Gururaj N. Postnatal depression among rural women in south India: Do socio-demographic, obstetric and pregnancy outcome have a role to play? *PLoS One*. 2015;10(4). doi:10.1371/journal.pone.0122079

32. Sword W, Kurtz Landy C, Thabane L, et al. Is mode of delivery associated with postpartum depression at 6 weeks: A prospective cohort study. *BJOG An Int J Obstet Gynaecol*. 2011;118(8):966-977. doi:10.1111/j.1471-0528.2011.02950.x

33. Arbabi M, Taghizadeh Z. Mode of Delivery and Post-partum Depression: A Cohort Study. *J Womens Heal Care*. 2016;05(01):1-5. doi:10.4172/2167-0420.1000303

34. Deng AW, Xiong RB, Jiang TT, Luo YP, Chen WZ. Prevalence and risk factors of postpartum depression in a population-based sample of women in Tangxia Community, Guangzhou. *Asian Pac J Trop Med*. 2014;7(3):244-249. doi:10.1016/S1995-7645(14)60030-4

35. Eckerdal P, Georgakis MK, Kollia N, Wikström A-K, Högberg U, Skalkidou A. Delineating the association between mode of delivery and postpartum depression symptoms: a longitudinal study. *Acta Obstet Gynecol Scand*. 2018;97(3):301-311. doi:10.1111/aogs.13275

36. Mahishale A, Bhatt J. Comparison of level of depression among mothers with lower

- segment cesarean section and vaginal delivery: A cross-sectional study. *J Sci Soc.* 2017;44(1):15. doi:10.4103/0974-5009.202547
37. Xie RH, Lei J, Wang S, Xie H, Walker M, Wen SW. Cesarean section and postpartum depression in a cohort of chinese women with a high cesarean delivery rate. *J Women's Heal.* 2011;20(12):1881-1886. doi:10.1089/jwh.2011.2842
38. Kim Y, Dee V. Sociodemographic and Obstetric Factors Related to Symptoms of Postpartum Depression in Hispanic Women in Rural California. *JOGNN - J Obstet Gynecol Neonatal Nurs.* 2018;47(1):23-31. doi:10.1016/j.jogn.2017.11.012
39. Malik FR, Malik BB, Irfan M. Comparison of postnatal depression in women following normal vaginal delivery and caesarean section: A pilot study. *J Postgrad Med Inst.* 2015;29(1):34-37.
40. Nayak M. Prevalence & related factors to postnatal depression: A comparison between NVD & LSCS mothers. *Int J Res Pharm Sci.* 2020;11(2):2228-2233. doi:10.26452/ijrps.v11i2.2175
41. Moameri H, Ostadghaderi M, Khatooni E, Doosti-Irani A. Association of postpartum depression and cesarean section: A systematic review and meta-analysis. *Clin Epidemiol Glob Heal.* 2019;7(3):471-480. doi:10.1016/j.cegh.2019.02.009
42. Xu H, Ding Y, Ma Y, Xin X, Zhang D. Cesarean section and risk of postpartum depression: A meta-analysis. *J Psychosom Res.* 2017;97:118-126. doi:10.1016/j.jpsychores.2017.04.016
43. Grivell RM, Dodd JM. Short- and long-term outcomes after cesarean section. *Expert Rev Obstet Gynecol.* 2011;6(2):205-215. doi:10.1586/eog.11.5
44. Gupta M, Saini V. Cesarean section: Mortality and morbidity. *J Clin Diagnostic Res.*

- 2018;12(9):QE01-QE06. doi:10.7860/JCDR/2018/37034.11994
45. Gupta S, Kishore J, Mala YM, Ramji S, Aggarwal R. Postpartum depression in North Indian women: Prevalence and risk factors. *J Obstet Gynecol India*. 2013;63(4):223-229. doi:10.1007/s13224-013-0399-x
46. Savarimuthu RJS, Ezhilarasu P, Charles H, Antonisamy B, Kurian S, Jacob KS. Postpartum depression in the community: A qualitative study from rural south India. *Int J Soc Psychiatry*. 2010;56(1):94-102. doi:10.1177/0020764008097756
47. Hahn-Holbrook J, Cornwell-Hinrichs T, Anaya I. Economic and Health Predictors of National Postpartum Depression Prevalence: A Systematic Review, Meta-analysis, and Meta-Regression of 291 Studies from 56 Countries. *Front Psychiatry*. 2018;8:1-23. doi:10.3389/fpsyt.2017.00248
48. Maharashtra D of E and SPDG of. *Economic Survey of Maharashtra 2019-20.*; 2020.
49. Sylvén SM, Papadopoulos FC, Mpazakidis V, Ekselius L, Sundström-Poromaa I, Skalkidou A. Newborn gender as a predictor of postpartum mood disturbances in a sample of Swedish women. *Arch Womens Ment Health*. 2011;14(3):195-201. doi:10.1007/s00737-011-0211-9
50. Gierszewska M, Kaźmierczak M, Araszkiewicz A, Gebuza G, Mieczkowska E, Gierszewska M. Psychosocial determinants of postpartum depression. *Med Biol Sci*. 2014;28(3):25-33. doi:10.12775/mbs.2014.022
51. Santos IS, Matijasevich A, Tavares BF, Barros AJ, Botelho IP, Lapolli C, Magalhães PV, Barbosa AP, Barros FC. Validation of the Edinburgh Postnatal Depression Scale (EPDS) in a sample of mothers from the 2004 Pelotas Birth Cohort Study. *Cadernos de saude publica*. 2007 Nov;23(11):2577.

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2  
3 52. Figueira P, Corrêa H, Malloy-Diniz L, Romano-Silva MA. Edinburgh Postnatal  
4 Depression Scale for screening in the public health system. *Revista de Saúde Pública*.  
5 2009;43:79-84.  
6  
7  
8  
9  
10 53. Rafferty J, Mattson G, Earls MF, et al. Incorporating Recognition and Management of  
11 Perinatal Depression Into Pediatric Practice. *Pediatrics*. 2019;143(1):e20183260.  
12  
13  
14 54. Goecke TW, Voigt F, Faschingbauer F, Spangler G, Beckmann MW, Beetz A. The  
15 association of prenatal attachment and perinatal factors with pre- and postpartum  
16 depression in first-time mothers. *Arch Gynecol Obstet*. 2012;286(2):309-316.  
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20  
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23  
24 55. Taherifard P, Delpisheh A, Shirali R, Afkhamzadeh A, Veisani Y. Socioeconomic,  
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- Figure 1 Block and type wise participating hospitals in Pune, India, 2017-18
- Figure 2 Women delivered and followed in Pune, India, 2017-18



**Table 1** Socio-demographic Characteristics of Study Participants (n=3,112), India, 2017-18

Characteristics		Caesarean (n=1556)	Vaginal (n=1556)	Total	Chi
		No (%)	No (%)	No (%)	Square (p)
Age in years	≤ 19	83 (5.38)	117 (7.59)	200 (6.48)	36.99 (<0.001)
	20 – 24	809 (52.40)	907 (58.82)	1716 (55.61)	
	25 – 29	485 (31.41)	415 (26.91)	900 (29.16)	
	30 – 34	133 (8.61)	93 (6.03)	226 (7.32)	
	> 35	34 (2.20)	10 (0.65)	44 (1.43)	
	Data not available	12	14	26	
Parity	1 <sup>st</sup> Para	632 (42.16)	638 (42.85)	1270 (42.50)	0.7 (0.87)
	2 <sup>nd</sup> Para	647 (43.16)	640 (42.98)	1287 (43.07)	
	3 <sup>rd</sup> Para	207 (13.81)	195 (13.10)	402 (13.45)	
	Multipara	13 (0.87)	16 (1.07)	29 (0.97)	
	Data not available	57	67	124	
Annual income in ₹ (1 ₹ =0.013 \$)	Less than 14,999	411 (28.88)	381 (27.27)	792 (28.09)	8.53 (0.01)
	15,000-99,999	933 (65.57)	967 (69.22)	1900 (67.38)	
	100,000+	79 (5.55)	49 (3.51)	128 (4.54)	
	Data not available@	133	159	292	
Education	Graduate/higher	242 (15.76)	153 (10.24)	395 (13.04)	37.74 (<0.001)
	12 <sup>th</sup> /Diploma after 10 <sup>th</sup>	422 (27.47)	356 (23.83)	778 (25.68)	
	High school (8-10 std.)	371 (24.15)	382 (25.57)	753 (24.85)	
	Middle school (5-7 std.)	246 (16.02)	304 (20.35)	550 (18.15)	
	Primary (1-4 std.)	154 (10.03)	159 (10.64)	313 (10.33)	
	Illiterate	101 (6.58)	140 (9.37)	241 (7.95)	
Occupation	Data not available	20	62	82	3.63 (0.72)
	Profession	29 (1.88)	17 (1.13)	46 (1.51)	

Semi-profession	12 (0.78)	14 (0.93)	26 (0.85)
Clerk, shop-owner, farmer	38 (2.47)	38 (2.52)	76 (2.50)
Skilled worker	33 (2.14)	32 (2.13)	65 (2.13)
Semi-skilled worker	20 (1.30)	24 (1.59)	44 (1.44)
Unskilled worker	32 (2.08)	29 (1.93)	61 (2.00)
Unemployed	1377 (89.36)	1351 (89.77)	2728 (89.56)
Data not available	15	51	65

std.=Standard; @ Includes not having ration card, hence no information about income

**Table 2** Comparison of postpartum depression with the mode of delivery, India, 2017-18

EPDS score	Caesarean (n=1424)	Vaginal (n=1407)	Emergency	Elective
0	55.20	57.71	57.51	49.35
1	6.46	7.46	6.37	7.52
2	9.55	10.73	8.75	11.76
3	7.09	7.11	6.65	8.82
4	7.23	5.47	6.65	9.80
5	3.72	3.91	3.42	4.58
<b>6</b>	<b>2.67</b>	<b>1.71</b>	<b>2.76</b>	<b>2.61</b>
<b>7</b>	<b>1.83</b>	<b>1.78</b>	<b>1.90</b>	<b>0.98</b>
<b>8</b>	<b>1.47</b>	<b>1.00</b>	<b>1.43</b>	<b>1.31</b>
<b>9</b>	<b>0.98</b>	<b>0.78</b>	<b>1.24</b>	<b>0.00</b>
<b>≥10</b>	<b>3.79</b>	<b>2.35</b>	<b>3.33</b>	<b>3.27</b>
Overall	Chi square=15.77 p=0.11		Chi square=16.23 p=0.09	
0-5 and >6	Chi square=7.99 p=0.005		Chi square=1.34 p=0.25	

EPDS= Edinburgh Postnatal Depression Scale

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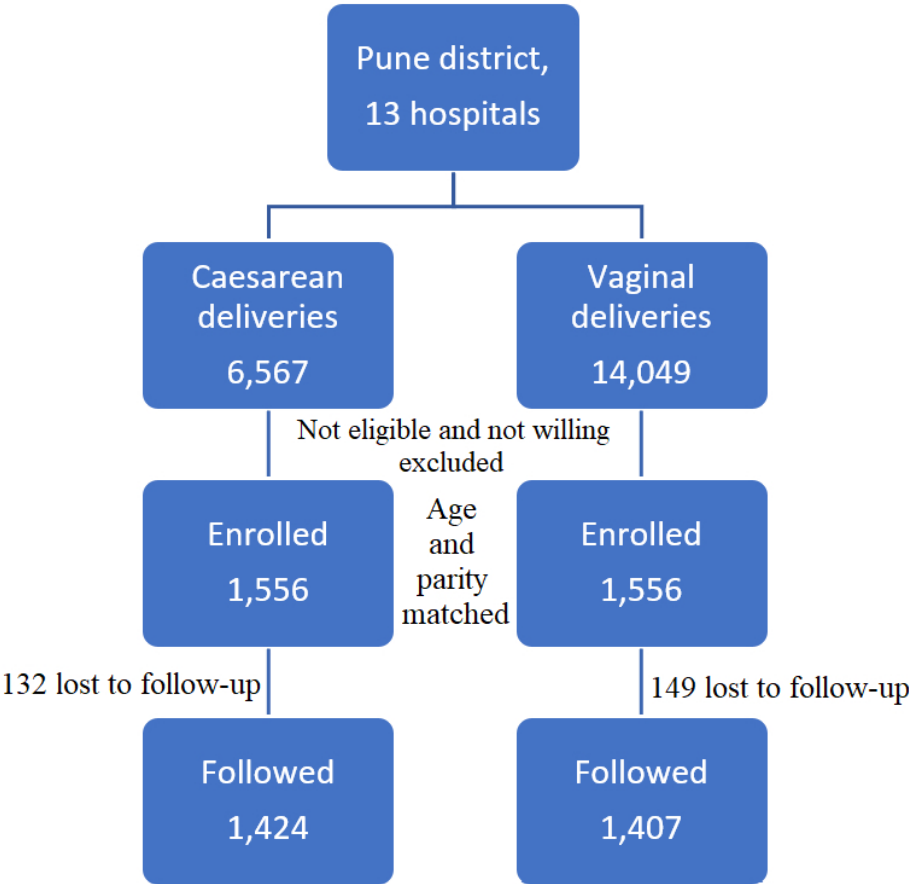
**Table 3** Multivariable logistic regression analysis of risk factors for post-partum depression, India, 2017-18

		EPDS Score		Total	Adj. Odds Ratio (95% CI)
		≥10	<10		
Age in years	<25	62	1673	1735	2.00 (1.16-3.43)
	≥25	25	1048	1073	1
Income	Non-BPL	62	1777	1839	1.51 (0.86-2.63)
	BPL	19	704	723	1
Education	≤ 10 <sup>th</sup> std.	31	1046	1077	0.78 (0.48-1.28)
	> 10 <sup>th</sup> std.	54	1628	1682	1
Occupation	Employed	8	281	289	1.07 (0.48-2.37)
	Unemployed	77	2412	2489	1
Parity	>2	12	385	397	1.10 (0.57-2.15)
	≤2	72	2251	2323	1
Mode of Delivery	Caesarean	54	1370	1424	1.88 (1.16-3.06)
	Vaginal	33	1374	1407	1

BPL=Below poverty line; EPDS= Edinburgh Postnatal Depression Scale;  
CI=Confidence Interval



**Figure 1** Block and type wise participating hospitals in Pune, India, 2017-18



**Figure 2** Women delivered and followed in Pune, India, 2017-18

369x397mm (57 x 57 DPI)

## STROBE (Strengthening The Reporting of OBservational Studies in Epidemiology) Checklist

A checklist of items that should be included in reports of observational studies. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

Section and Item	Item No.	Recommendation	Reported on Page No.
Title and Abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	
Introduction			
Background/Rationale	2	Explain the scientific background and rationale for the investigation being reported	
Objectives	3	State specific objectives, including any prespecified hypotheses	
Methods			
Study Design	4	Present key elements of study design early in the paper	
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	
Participants	6	(a) Cohort study—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up  Case-control study—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls  Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants	
		(b) Cohort study—For matched studies, give matching criteria and number of exposed and unexposed  Case-control study—For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	

Section and Item	Item No.	Recommendation	Reported on Page No.
Data Sources/ Measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	
Bias	9	Describe any efforts to address potential sources of bias	
Study Size	10	Explain how the study size was arrived at	
Quantitative Variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical Methods	12	(a) Describe all statistical methods, including those used to control for confounding	
		(b) Describe any methods used to examine subgroups and interactions	
		(c) Explain how missing data were addressed	
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive Data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	
Outcome Data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	

Section and Item	Item No.	Recommendation	Reported on Page No.
Main Results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	
		(b) Report category boundaries when continuous variables were categorized	
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other Analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
<b>Discussion</b>			
Key Results	18	Summarise key results with reference to study objectives	
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	
Generalisability	21	Discuss the generalisability (external validity) of the study results	
<b>Other Information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Once you have completed this checklist, please save a copy and upload it as part of your submission. DO NOT include this checklist as part of the main manuscript document. It must be uploaded as a separate file.**